NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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For Release:
January 2, 1989
3 P.M. EST

RELEASE: 90-1

ASTRONAUT CREW NAMED TO INTERNATIONAL MICROGRAVITY MISSION

USAF Col. Ronald J. Grabe has been named to command STS-42, a 9-day mission aboard Space Shuttle Columbia in December 1990. Stephen S. Oswald will be the pilot, and William F. Readdy will fly as a mission specialist.

Columbia will carry the International Microgravity Laboratory in which five NASA astronauts and two payload specialists will conduct a variety of studies and experiments in the fields of materials processing and life sciences.

Mary L. Cleave, Ph.D., and Norman E. Thagard, Ph.D., were assigned to the flight as mission specialists in June 1989. Two payload specialists will be named in the near future.

Grabe, commanding his first Shuttle mission, flew previously as pilot on STS-51J in October 1985 and on STS-30 in May 1989. He was born June 13, 1945 in New York.

Oswald will make his first space flight. Born June 30, 1951, in Seattle, he considers Bellingham, Wash., his hometown.

Readdy, also making his first flight, was born Jan. 24, 1952, in Quonset Point, R.I., but considers McLean, Va., his hometown.

Cleave, mission specialist on STS-61B in November 1985 and on STS-30 in May 1989, was born Feb. 5, 1947, in Southampton, N.Y.

Thagard, mission specialist on STS-7 in June 1983, STS-51B in April 1985 and on STS-30 in May 1989, was born July 3, 1943, in Marianna, Fla., but considers Jacksonville, Fla., his hometown.

- end-

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XH

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For Release:
January 3, 1990

RELEASE: 90-2

ADVANCED TRACKING AND DATA RELAY SATELLITE PHASE B RFP RELEASED

NASA today released the request for proposal (RFP) for the Advanced Tracking and Data Relay Satellite System (ATDRSS). The RFP requests that companies demonstrate their ability and capacity to design, manage, integrate and test large, modern communications spacecraft and associated ground facilities.

In the recently completed study phase, Goddard Space Flight Center, Greenbelt, Md., had awarded contracts in September 1987 totaling approximately $9.3 million to five contractors -- Ford Aerospace and Communication Corp.; General Electric Astrospace; Hughes Space and Communications Group; Lockheed Missiles and Space Company, Inc.; and TRW Space and Technology Group -- for an 18-month design feasibility study of the ATDRSS.

The first ATDRSS spacecraft tentatively is scheduled for delivery in July 1997, when it could be used to replace one of the Tracking and Data Relay Satellites (TDRS) currently in use. "A four-satellite constellation of ATDRSS is expected to be in orbit and operational by 2001," according to Thomas C. Underwood, Assistant Chief for the TDRS System at Goddard. ATDRSS is intended to maintain the present NASA track and data relay system through the first decade of the 21st Century.

The current TDRS system, which includes geostationary satellites and one operational ground facility and a second ground facility to become operational in 1993, has replaced most of the ground network of tracking stations used by NASA to track and communicate with its low Earth-orbiting spacecraft. The TDRS system provides improved communications coverage for the Space Shuttle. Future missions that will use the system include the Hubble Space Telescope, Space Station Freedom and the Earth Observation System.

- more -

NASA currently has three TDRS satellites in orbit and three more in various phases of construction. By the end of the next decade, these satellites are expected to reach the end of their useful life and will require replacement. The ATDRSS satellite sought by NASA will provide the necessary continuation to meet user needs.

"The advanced satellites," explained William S. Guion of Goddard's Tracking and Data Relay project office, "will differ from the existing TDRS spacecraft in two important respects: a new frequency band with a high-data rate capability of 650 million bits per second; and an enhanced multiple access system which will increase the data rate provided each of several simultaneous users from the current 50 thousand bits per second to 3 million bits per second."

These higher communication rates will be needed primarily for relaying to Earth the high resolution images resulting from scientific and application missions on Space Station Freedom.

Three TDRS currently in orbit are: TDRS-3 (TDRS-West), 171 degrees west longitude, over the Pacific Ocean southwest of the Hawaiian Islands and just east of the Gilbert Islands; TDRS-4 (TDRS-East), which recently replaced TDRS-1 at the east location, 41 degrees west longitude, over the Atlantic Ocean off the northeast coast of Brazil; and TDRS-1, which has been moved to approximately 79 degrees west longitude, over the west coast above the Equador, as an on-orbit spare.

The current TDRS spacecraft, the largest and most complex operational communication satellites in the world, are built by TRW, Redondo Beach, Calif., and are owned and operated by CONTEL Federal Systems, Fairfax, Va.

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For Release:
January 5, 1990
3 P.M. EST

RELEASE: 90-3

TRULY MAKES KEY APPOINTMENTS

NASA Administrator Richard H. Truly today named Thomas E. Utsman as the Deputy Associate Administrator for Space Flight (Management) and James A. "Gene" Thomas as the Deputy Director of the John F. Kennedy Space Center, Fla.

In his new capacity, Utsman will have overall responsibility for assisting William B. Lenoir, Associate Administrator for Space Flight, in the day-to-day oversight management of the Space Flight programs. Specific responsibilities will include overseeing procurement activities, assessing program management performance and conducting long-range operational planning. George Abbey continues in his capacity as Deputy Associate Administrator.

Utsman was both Deputy Director of Kennedy Space Center, a post he held since August 1985, and Director of Space Transportation System Mangement and Operations, with responsibility for the engineering management and technical direction of return-to-flight activities in the post-Challenger era, which he performed from December 1986 until March 1989.

Utsman began his NASA career in 1963 as a facilities design engineer in the Apollo program. In 1971 he was named to head the Design Engineering Directorate's Project Engineering Office, which was assigned the task of converting old facilities and building new facilities for launching the Space Shuttle. He subsequently served as Deputy Director of Project Management; Associate Director of Design Engineering; Director, Operations Management; Deputy Director and Director of Technical Support; Director of Shuttle Operations; and Director of Shuttle Management and Operations.

-more-

Born in Detroit, Michigan, Utsman was graduated from Fordson High School, Dearborn, in 1954. He received a Bachelor of Science degree in Mechanical Engineering from the University of Michigan in 1958 and a Master's Degree in Management from Florida State University in 1968.

Utsman has been the recipient of numerous honors and awards, including the NASA Distinguished Service Medal and, most recently, the Presidential Rank of Meritorious Executive for his outstanding contributions to the Space Shuttle return-to-flight effort.

Thomas, who will serve as Deputy Director under Forrest S. McCartney, has been the KSC Director of Safety, Reliability and Quality Assurance since January 1987. In that post he has been responsible for developing and implementing overall safety policy and procedures at KSC and activities relating to KSC progams at Cape Canaveral Air Force Station, Fla., and Vandenberg Air Force Base, Calif.

He joined NASA in 1962 and served as lead engineer for prelaunch testing and checkout of communications systems on the Apollo spacecraft.

Thomas became active in Space Shuttle activities early in the progam, serving as the lead flight project engineer on the KSC engineering team which participated in Orbiter Vehicle 101 (Enterprise) Approach and Landing Tests conducted at Edwards AFB, Calif., in 1976 and 1977.

From November 1977 until June 1983, Thomas was lead orbiter flight project engineer for the Space Shuttle orbiter Columbia, first vehicle in the fleet to begin space flight. He later became chief shuttle flight project engineer, Shuttle Engineering Directorate, with overall responsibility for integration of all testing and checkout of Shuttle orbiters, external tanks and solid rocket booster flight hardware.

From September 1985 until December 1986, Thomas served as Acting Director and subsequently Director, of Shuttle Launch and Landing Operations.

A native of Meridian, Miss., Thomas received his Bachelor of Science degree in electrical engineering from Mississippi State University in 1962. He was graduated from Florida State University with a master's degree in technical management in 1973.

His awards include the NASA Exceptional Service Medal in 1981 and the Outstanding Leadership Medal in 1989.

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For Release:
January 8, 1990

RELEASE: 90-4

NASA AND JAPAN SIGN GEOTAIL AGREEMENT

NASA and Japan have completed an agreement for the launch of Japan's GEOTAIL spacecraft on a Delta II launch vehicle, from the Kennedy Space Center, Fla., in July 1992. Richard H. Truly, NASA Administrator, and Professor Jun Nishimura, Director-General of Japan's Institute of Space and Astronautical Science (ISAS), signed the agreement on behalf of the U.S. and Japanese agencies implementing this cooperative activity.

The GEOTAIL spacecraft is a bilateral cooperative mission between NASA and ISAS which will investigate the stored energy in the geomagnetic tail of the Earth. GEOTAIL will use a double lunar-swingby orbit to take measurements in the region from 8 to 220 Earth radii (Re).

These data will be compared with other NASA missions in the Global Geospace Science (GGS) Program. GGS will investigate cause and effect relationships in the global flow of energy in the Earth's magnetosphere. Following the geomagnetic tail investigation, GEOTAIL will move to an 8 by 32 Re orbit to conduct studies in the equatorial magnetosphere.

NASA will contract for the launch services for Geotail. NASA recently competitively awarded the McDonnell Douglas Corp. a contract to provide medium performance class launch services for a series of its missions on their commercial Delta II launch vehicle. GEOTAIL will be the first mission in the series of launch services.

ISAS will provide some of the science instruments in addition to the spacecraft. NASA also will provide science instruments and tracking via the Deep Space Network. The science data from GEOTAIL will be shared among all the participants in the GGS program.

GEOTAIL is the largest NASA/Japan international cooperative space science mission to date.

- end -

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For Release:
January 11, 1990

RELEASE: C90-a

JSC EXTENDS ROCKWELL SYSTEMS INTEGRATION CONTRACT

NASA's Johnson Space Center (JSC) has awarded Rockwell International Corp., Space Transportation Systems (STS) Division, Downey, Calif., a 5-year extension on a systems integration contract, beginning Jan. 1, 1990.

The total estimated value of the cost-plus-award-fee arrangement is $580,729,000, for approximately 8,337,000 level-of-effort man hours. Additionally, an option valued at $91,873,000 was negotiated for 1,251,000 level-of-effort man-hours.

The work will be completed at Rockwell's Downey facility, as well as at JSC, the Marshall Space Flight Center, and the Kennedy Space Center.

Systems integration includes both flight and ground systems engineering maintenance and analysis; safety, quality assurance, and reliability analysis; configuration and information management; and integration of systems within the orbiter. The activity on this contract includes configuring the hardware required for each orbiter flight.

-end-

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For Release:
January 11, 1990

RELEASE: c90-b

JSC SIGNS OPERATIONS SUPPORT CONTRACT WITH ROCKWELL

NASA's Johnson Space Center (JSC) has signed a 5-year extension of an orbiter operations support contract with Rockwell International Corp., Downey, Calif. The extension began Jan. 1, 1990 and continues through Dec. 31, 1994. It is a continuation of tasks being performed under an existing contract originally effective in 1984.

The value of the cost-plus-award-fee contract is $605,088,000, which provides for a total base effort of 9,320,000 man-hours over a five-year period. Additionally, a firm price option for 1,200,000 man-hours at a cost-plus-award-fee value of $79,552,000 may be exercised in part or whole at any time during the period of performance.

Orbiter operations support includes such necessary engineering support, as real-time flight mission support from countdown through landing; ground support for checkout and turnaround of orbiter vehicles; and updating of the Shuttle Avionics Integration Laboratory (SAIL). Services also provided are configuration management, which includes the maintenance of existing configuration records for delivered orbiter vehicles and support equipment necessary to document all changes, as well as providing the current status of hardware configuration.

In addition, Rockwell will provide launch support services at Kennedy Space Center (KSC) that assure the orbiter vehicles and subcontractor-furnished ground support equipment configuration documentation are maintained to reflect the effects of work performed on hardware at KSC.

The operations support effort will be completed at Rockwell's Downey facility, as well as at JSC and KSC.

-end-

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January 13, 1990
Embargoed for
9:30 a.m. EST

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RELEASE: 90-5

EARLY COBE RESULTS IN ACCORD WITH BIG BANG THEORY

A major advance in cosmology was revealed today as early results from NASA's Cosmic Background Explorer (COBE), launched last fall, were presented at the American Astronomical Society meetings held at Crystal City, Va.

Preliminary results are in accord with the predictions of the Big Bang theory, which traces the origin of the universe to a primordial explosion some 15 billion years ago. The universe today shows that sometime after the Big Bang additional release(s) of energy must have occurred. COBE's new results severely limit the magnitude and character of such a release.

Limited COBE data now indicate a smooth, uniform Big Bang. However, small deviations from a blackbody spectrum -- the characteristic signature of radiation from an opaque object of uniform temperature -- would reveal energetic processes in the early universe.

COBE scientists reported that the instruments onboard the spacecraft are performing exquisitely with precision never before achieved. Such precision puts new constraints on theories to explain the present universe.

Over the 2-year mission, COBE will continue to collect much more data. Scientists expect the final data to be ten times more sensitive than these early results.

These early results were reported to the American Astronomical Society by the principal investigators for the three instruments: the Far Infrared Absolute Spectrophotometer (FIRAS), the Differential Microwave Radiometer (DMR) and the Diffuse Infrared Background Experiment (DIRBE).

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Dr. John Mather, Principal Investigator for FIRAS and Project Scientist, reported that the spectrum measurement of the cosmic microwave background (a relic of the Big Bang) is highly accurate and heralds a major advance in observational cosmology. Based on a small sample of data, FIRAS measurements show no deviation from a blackbody spectrum as large as one percent of the peak brightness of the cosmic microwave background over the wavelength range 500 microns to 5 millimeters.

When FIRAS captured these data, it was pointed toward the North Galactic Pole, where emissions from our own galaxy, the Milky Way, are expected to be low. Using only 9 minutes of sky observations, FIRAS already has produced the most precise cosmic microwave background spectrum measurement ever made. Much more exposure time will be obtained during the mission.

Dr. George Smoot, Principal Investigator for the DMR, presented the first COBE maps of the variation in brightness of the cosmic background radiation over the sky. The maps, taken at frequencies of 31, 53 and 90 GHz, indicate that the cosmic background radiation is equally bright in all directions. The question of what and where are the progenitors of galaxies and large clusters of galaxies is still open.

The preliminary results from DMR are based on only about 20 days of data and also indicate the extraordinary smoothness of the universe. This instrument will continue to take data for two years, which will improve its sensitivity to search for anisotropies, or "lumpiness," in the early universe well beyond the present limits.

Dr. Michael Hauser, Principal Investigator for DIRBE, showed maps of half the sky taken at wavelengths of 1.2, 12, and 240 microns (never before achieved for the 1.2 and 240 micron wavelengths). Final maps from this experiment will enable COBE scientists to search for radiation from the first stars and galaxies.

These initial maps, taken over a one-week period, clearly reveal bright foreground radiation from stars, dust in our own Solar System, and interstellar dust. DIRBE maps half the entire sky every day at 10 different wavelengths and it covers the entire sky in 6 months.

At the AAS meeting, Dr. Nancy W. Boggess, Deputy Project Scientist, gave an overview of the mission, reporting that COBE has met or exceeded all design goals. At launch, all systems deployed as planned. The RF/Thermal Shield, which protects all three instruments from solar and terrestrial radiation, is more spectacular than hoped.

-more-

This efficient shield results in a lower than anticipated temperature of the dewar, the giant thermos bottle that maintains the FIRAS and DIRBE at operating temperatures below 2 degrees K. The dewar now operates at 1.4 degrees K, though designed for 1.6 degrees K less. The lower temperature will enable the detectors of the COBE instruments to be more sensitive. It also makes the lifetime of the liquid helium, which keeps the dewar cryogenically cooled, longer than the original 12 to 14 months. It is now expected to last 430 days.

COBE was launched Nov. 18, 1989, aboard the last NASA-owned Delta rocket, from the Vandenberg Air Force Base, Calif. COBE is managed by NASA's Goddard Space Flight Center, Greenbelt, Md., for the Office of Space Science and Applications. GSFC is responsible for the design, development and flight operations, as well as for the development of the analysis software and for the production of the final mission data sets.

The COBE science team consists of Drs. Charles L. Bennett, Nancy W. Boggess, Edward S. Cheng, Eli Dwek, Michael G. Hauser, Thomas Kelsall, John C. Mather, S. Harvey Moseley, Jr., Richard A. Shafer and Robert F. Silverberg, all of the Goddard center; Drs. Samuel Gulkis and Michael A. Janssen of the Jet Propulsion Laboratory; Dr. Philip M. Lubin of the University of California at Santa Barbara; Drs. Stephan S. Meyer and Rainer Weiss of the Massachusetts Institute of Technology; Dr. Thomas L. Murdock of the General Research Corporation; Dr. George F. Smoot of the University of California, Berkely; Dr. David T. Wilkinson of Princeton University; and Dr. Edward L. Wright of the University of California at Los Angeles.

NOTE TO EDITORS: Photographs to complement this release are available from the NASA Headquarters Audio-Visual Branch by calling 202/453-8383 or the Goddard Space Flight Center Public Affairs Office at 301/286-6256. Ask for:

Color:	90-HC-20
	90-HC-21
	90-HC-22
B&W	90-H-20
	90-H-21
	90-H-22

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For Release:
January 16, 1990

RELEASE: 90-6

FIRING 'OLD' SHUTTLE ROCKET MOTORS HAS BENEFITS FOR FUTURE

Key design changes in the Space Shuttle's solid rocket motors, made following the Challenger accident in 1986, have long since been completed and certified flightworthy by extensive testing. The redesigned rockets have successfully boosted the Shuttle into orbit eight times since September 1988.

So why is NASA conducting ground firings of Shuttle solid rocket motors of the pre-Challenger design? Because static firings in the Technical Evaluation Motor series are yielding a variety of benefits for the agency's solid rocket motor program, managed by the Marshall Space Flight Center, Huntsville, Ala.

The primary reason for conducting the firings is to reclaim millions of dollars worth of solid rocket motor casings and associated hardware for future reuse. The casings are specially forged, 12-foot-in-diameter cylindrical metal segments in which propellant is poured and cast, creating the four massive elements from which each 126-foot-long motor is assembled.

Casings are refurbished and reused as many as 20 times. In normal operations, the expended motors are recovered from the ocean following the Shuttle's ascent, then disassembled and inspected, after which the casings and other components are recycled.

At the time of the Challenger accident, 11 solid rocket motors had been produced but not used. With minor rework, the reusable components of these motors are interchangeable with those on the current-design motor. But, since there is no practical, safe way to scrape or wash the highly flammable propellant out of the segments, the motors have to be fired to reclaim the hardware.

-more-

"The Shuttle program has accelerated to a launch rate near that which was under way at the time of the Challenger accident," said Royce Mitchell, manager of the Redesigned Solid Rocket Motor Project at the Marshall Center. "The use of these reclaimed motor segments is vital to supporting our flight manifest and represents several million dollars in cost savings to the Shuttle program," Mitchell added.

Three of the Technical Evaluation Motor firings -- those scheduled for the fall of 1990 through the spring of 1991 -- will serve another purpose equally vital to maintaining the Shuttle's future flight schedule. NASA is currently in the process of qualifying a new supplier for a type of rayon yarn used in nozzle components of the solid rocket motor. The quality and characteristics of the rayon can be only partially assessed with laboratory tests. To fully certify that the material meets specifications for flight, it must be used to fabricate actual nozzle components, which then must be subjected to full-duration motor firings. The technical evaluation motors provide a low-cost opportunity to do this, since the pre-Challenger motors contain the same 1.1 million pounds of propellant as in the current design, producing the same environments and demands on the nozzle as a current flight motor.

As an added benefit, the firings provide an opportunity for engineers to obtain new data that will expand their knowledge about motor performance in general.

"For instance, the effects of aging and storage are important to understand. The last of these motors will be several years old when fired, so the data will be very valuable for technical assessment," Mitchell explained.

The test series is being conducted by Thiokol Corp., NASA's prime contractor for the solid rocket motor program, at the company's northern Utah test facility. The firings began in November 1988, with four motors fired thus far. Tests are scheduled to continue through late 1991.

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For Release:
January 17, 1990

N90-3
NOTE TO EDITORS:
TOMATO SEEDS EXPERIMENT FEATURED IN SATELLITE VIDEO CONFERENCE

On Jan. 23, NASA's Educational Affairs Division, Washington, D.C., through Oklahoma State University, Stillwater, will transmit via satellite an educational, video conference to discuss the student tomato seed experiment to be distributed in late February to schools across the nation to study the effects of long-term space exposure on living tissue.

The Space Exposed Experiment Developed for Students (SEEDS), one of 57 experiments housed on the Long Duration Exposure Facility (LDEF), has been in space since April 1984. The crew of Shuttle Columbia rescued the 11-ton satellite Jan. 12 and plans to return to Earth Jan. 19, ending a 10-day mission. SEEDS will be distributed in kits to teachers of upper elementary to the university level for experiments and study.

Dr. William Kinard, LDEF Project Scientist, NASA's Langley Research Center, Hampton, Va., will discuss the "treasure trove" of data expected from LDEF's prolonged exposure to radiation, vacuum, meteoroids and temperature extremes of space.

SEEDS is a cooperative project between NASA and Park Seed Company, Greenwood, S.C. During the video conference, Dr. Jim Alston, Project Scientist at Park Seed Co., will show how the tomato seeds were prepared for LDEF and will discuss the packaging process and initial experiments.

These live, 1-1/2 hour, interactive, video conferences are designed to update teachers on NASA programs, demonstrate aerospace activities for the classroom and announce new programs, products and activities available to classroom teachers. More than 20,000 educators in 50 states are expected to participate.

The Jan. 23 conference will be transmitted on Westar IV, channel 19, from 2:30 to 4 p.m. EST. There is no charge for registration or participation in the video conference.

News media and organizations interested in participating can access the satellite or view the event from NASA Headquarters, 400 Maryland Ave., S.W., room 6004, Washington, D.C.

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For Release:
January 17, 1990
3:00 p.m. EST

RELEASE: 90-7

1990 ASTRONAUT CANDIDATES SELECTED

In the first of what will become standard biennial selections, 23 new astronaut candidates have been named for the Space Shuttle program.

The candidates were chosen from among 1,945 qualified applicants, 106 of whom received interviews and medical examinations between September and November 1989. They will report to the Johnson Space Center, Houston, in July to begin a year of training and evaluation, after which they will receive technical assignments leading to selection for Shuttle flight crews.

The 1990 group consists of 7 pilot candidates and 16 mission specialist candidates, including 11 civilians and 12 military officers. Among the 5 women selected are 3 military officers, including the first woman to be named as a pilot candidate, and the first Hispanic woman to be chosen. A listing of the candidates and biographical data follows.

A listing of the candidates and their birthplaces follow. A listing of the candidates and short biographical sketches are available from all NASA newsrooms.

-more-

1990 ASTRONAUT CANDIDATES

Lcdr. Daniel W. Bursch Bristol, Pa.	U.S. Navy	Mission Specialist
Dr. Leroy Chiao Milwaukee, Wisc.	Civilian	Mission Specialist
Maj. Michael R.U. Clifford Norton AFB, Calif.	U.S. Army	Mission Specialist
Kenneth D. Cockrell Austin, Texas	Civilian	Pilot
Maj. Eileen M. Collins Elmira, N.Y.	U.S. Air Force	Pilot
Capt. William G. Gregory Lockport, N.Y.	U.S. Air Force	Pilot
Maj. James D. Halsell, Jr. Monroe, La.	U.S. Air Force	Pilot
Dr. Bernard A. Harris, Jr. Temple, Texas	Civilian	Mission Specialist
Capt. Susan J. Helms Charlotte, N.C.	U.S. Air Force	Mission Specialist
Dr. Thomas D. Jones Baltimore, Md.	Civilian	Mission Specialist
Maj. Wm. S. McArthur, Jr. Laurinburg, N.C.	U.S. Army	Mission Specialist
Dr. James H. Newman Trust Territory of the Pacific Islands	Civilian	Mission Specialist
Dr. Ellen Ochoa Los Angeles, Calif.	Civilian	Mission Specialist
Maj. Charles J. Precourt Waltham, Mass.	U.S. Air Force	Pilot
Capt. Richard A. Searfoss Mount Clemens, Mich.	U.S. Air Force	Pilot
Dr. Ronald M. Sega Cleveland, Ohio	Civilian	Mission Specialist

Capt. Nancy J. Sherlock Wilmington, Del.	U.S. Army	Mission Specialist
Dr. Donald A. Thomas Cleveland, Ohio	Civilian	Mission Specialist
Dr. Janice E. Voss South Bend, Ind.	Civilian	Mission Specialist
Capt. Carl E. Walz Cleveland, Ohio	U.S. Air Force	Mission Specialist
Maj. Terrence W. Wilcutt Russellville, Ky.	U.S. Marine Corps	Pilot
Dr. Peter J. K. Wisoff Norfolk, Va.	Civilian	Mission Specialist
Dr. David A. Wolf Indianapolis, Ind.	Civilian	Mission Specialist

-end-

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For Release:
January 18, 1990

RELEASE: 90-8

RESEARCH EXPERIMENTS TO MONITOR COLUMBIA RE-ENTRY

During Columbia's fiery re-entry through Earth's atmosphere at mission end, two experiments will measure the orbiter's aerodynamic and thermodynamic characteristics to acquire data for future space transportation systems.

STS-32 is the third flight of the Shuttle Infrared Leeside Temperature Sensing (SILTS) and the Shuttle Entry Air Data System (SEADS) experiments, developed by Langley Research Center, Hampton, Va., in NASA's Orbiter Experiments (OEX) program.

The OEX program conducts atmospheric entry research during the Shuttle orbiter's return from space. OEX experiments are placed within the orbiter structure for data collection, leaving the payload bay free to support the flight's primary payloads. SILTS and SEADS previously flew on STS-61C in January 1986 and on STS-28 in August 1989.

On STS-32, SILTS will gather additional data to predict thermal protection requirements for the upper surfaces of advanced entry vehicles. As Columbia slows from orbital speed down to about Mach 8 (eight times the speed of sound), an infrared camera located in a pod at the tip of the orbiter's vertical tail will gather high-resolution infrared imagery of the upper (leeward) left wing. Researchers will use the data to produce detailed thermal maps showing the magnitude and distribution of aerodynamic heating.

On STS-28, SILTS images revealed increased temperatures just behind the leading edge of the wing and in an area between the inboard and outboard elevons flight control surfaces which reached around 1,100 degrees Fahrenheit.

- more -

Prior to the experiment's next flight on the STS-35 mission scheduled for April 1990, the experiment will be reconfigured to monitor Columbia's upper fuselage.

The SILTS results are vital to the design of advanced winged spacecraft because each pound of unnecessary thermal protection that can be eliminated allows another pound of payload to be carried for the same launch cost. Moreover, SILTS collects data under flight conditions that can not be duplicated in ground-based facilities.

SEADS is housed in Columbia's nosecap. The experiment incorporates 14 penetration assemblies distributed about the nosecap surface, each containing a small port through which local surface air pressure is measured.

Measurement of air pressure distribution allows precise post-flight determination of "air data" such as angle of attack, angle of sideslip, free stream dynamic pressure and Mach number. Accurate information on these factors, coupled with vehicle motion information measured by a separate experiment, are required to determine the orbiter's aerodynamic flight characteristics. SEADS provides accurate data during ascent from liftoff to about 56 miles and from that altitude through landing during re-entry.

The principal technologists for SILTS are David A. Throckmorton and E. Vincent Zoby of Langley's Space Systems Division. Paul M. Siemers III of the Space Systems Division is the principal technologist for SEADS.

- end -

NOTE TO EDITORS: A photograph (B&W: 89-H-648) is available to illustrate this release by calling 202/453-8375.

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For Release:
January 19, 1990
4 P.M. EST

LAUNCH ADVISORY: LAUNCH OF HUBBLE SPACE TELESCOPE RESCHEDULED

Launch of STS-31 mission to deploy the Hubble Space Telescope has been rescheduled for no earlier than April 19. The delay is to allow time to remove and replace the aft solid motor segment and nozzle of the right solid rocket booster (SRB) used to help boost the STS-31 Space Shuttle vehicle into orbit.

Engineers decided to change the segment and nozzle because they could not verify that a critical joint in the SRB nozzle had been properly leak checked at the factory. "The factory leak check in question is absolutely necessary to assure that the joint, or the O-ring on that joint, is not defective in any way," said Space Shuttle Director Robert Crippen. "In this case, we believe it was necessary to take a conservative approach and have decided to replace the joint with one that has an absolutely clean bill of health. All of us in the program are looking forward to launching the Hubble Space Telescope, which will be one of the most exciting missions of 1990."

The right-hand aft segment and nozzle will be taken off of the Mobile Launcher Platform, currently in the Vehicle Assembly Building at the Kennedy Space Center, and replaced with hardware being shipped today to Florida from the Thiokol facility in Utah. Delivery to KSC is planned for next week.

The 43-foot Hubble Space Telescope will be the largest astronomical observatory ever placed in orbit. Hubble will be deployed from the Shuttle some 370 miles above Earth where it will observe the universe for 15 years or longer.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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(Phone: 202/453-8455)

For Release:
January 19, 1990

RELEASE: 90-9

NASA ANNOUNCES PAYLOAD SPECIALISTS FOR SPACELAB IML-1 MISSION

NASA today announced, after consultation with the Canadian Space Agency (CSA) and the European Space Agency (ESA), that Dr. Ulf D. Merbold, ESA, and Dr. Roberta L. Bondar, CSA, have been designated as the prime flight payload specialists for the first International Microgravity Laboratory mission (IML-1) aboard the Space Shuttle Columbia currently scheduled for launch in December 1990.

Dr. Kenneth E. Money, CSA, and Dr. Roger K. Crouch, NASA Headquarters, have been selected as the backup payload specialists. Dr. Money and Dr. Crouch will be principle communicators with the laboratory during the mission from the Payload Operations Control Center at the Marshall Space Flight Center, Huntsville, Ala. They also will train for the payload mission such that they could substitute for Dr. Bondar and Dr. Merbold should they be unable to fly the mission.

These Payload Specialist designations were made based on recommendations of the IML-1 Investigators Working Group.

IML-1 is the first of a series of microgravity investigations using the Spacelab module. An international team consisting of over 200 investigators from more than a dozen countries will focus on materials and life sciences, two disciplines needing crew participation and access to reduced gravity. IML-1 will use the Spacelab long module and is a dedicated microgravity mission.

The investigations will use four life sciences experiment facilities, designed for multiple experiments, including biorack, gravitational plant physiology facility, microgravity vestibular investigations and space physiology experiments.

- more -

Six materials experiment facilities also will be used, including fluid experiment system, vapor crystal growth system, mercury-iodide crystal growth system, organic crystal growth facility, the critical point facility and protein crystal growth facilities. These multi-experiment facilities have been built by the U.S., European, Canadian and Japanese investigators and organizations.

In addition to the experiments which require these multiuser facilities, two other life science and three other materials science experiments with unique hardware will fly aboard IML-1.

Columbia will fly in a 165 nautical mile-high, 28.5 degree orbit. Mission duration is planned for 9 days. A 10th day will be flown if flight resources allow.

The orbiter will fly in a "gravity gradient" attitude (tail toward Earth) thereby producing the least gravitational disturbances on the Spacelab during the mission flight duration.

The crew will consist of the two payload specialists and two payload-oriented mission specialists, Dr. Mary L. Cleave and Dr. Norman E. Thagard; Mission Commander, Colonel Ronald J. Grabe, USAF; Pilot, Stephan S. Oswald; and a 3rd general mission specialist, William F. Readdy.

The IML series is intended as an ongoing international research program in materials and life sciences in a microgravity environment. The program is managed by NASA's Office of Space Science and Applications' Flight Systems Division, Washington, D.C. Wayne Richie is the IML-1 Program Manager and Dr. Ronald White, Life Sciences Division, is the Program Scientist.

The IML-1 Mission Manager is Robert McBrayer and the Mission Scientist is Dr. Robert Snyder, both from the Marshall Space Flight Center.

- end -

NASA News

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(Phone: 301/286-5565)

For Release:
January 24, 1990

RELEASE: 90-10

MANAGEMENT OF POLAR PLATFORM TO CHANGE

NASA Administrator Richard H. Truly has approved a plan to transfer the management of the polar orbiting platform, currently under development by the Office of Space Flight as part of the Space Station Freedom program, to the Office of Space Science and Applications which has responsibility for the proposed Earth Observing System (EOS) program.

President Bush has made preservation of the environment a top priority. NASA's EOS is a key element of the overall Mission to Planet Earth initiative, the purpose of which is to produce the understanding needed to predict changes in the Earth's environment. EOS will observe the Earth from polar orbit to understand the processes that control the global environment.

EOS is planned to be a major new effort within NASA, and the unmanned polar platform will be the first piece of hardware to be built for this program. "This gives the responsibility for managing the EOS platform to the office responsible for carrying out the EOS mission," said Dr. William B. Lenoir, Associate Administrator for Space Flight. "In a management sense, it puts the development and operation of the platform closer to the users of the platform."

Plans for EOS observations have been developed in coordination with NASA's international partners. "This transition plan was discussed with our international partners and we have assured them that agreements between us will be honored in all regards," said Lenoir.

- more -

The role of the Goddard Space Flight Center, Greenbelt, Md., which manages the EOS program and the polar platform, has not been altered by this decision. Goddard will continue to play a vital role in the Freedom program as the NASA center responsible for developing the Flight Telerobotic Servicer, a space robot that will be used in the assembly and maintenance of the manned base.

Goddard will retain its management responsibility for developing the platform with General Electric Astro Space, Princeton, N.J., as the prime contractor. Current plans call for the U.S. platform to be launched in 1998 on a Titan IV rocket from Vandenberg Air Force Base, Calif. The platform will have an orbital lifetime of at least 5 years.

Transition of management of the polar platform will be conducted during the 1990 fiscal year. Beginning in FY 1991, complete responsibility for the polar platform will be transferred to the Office of Space Science and Applications.

- end -

NASA News

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For Release:
January 24, 1990

RELEASE: 90-11

LONG DURATION EXPOSURE FACILITY SHOWS FEW SURPRISES

Television views, astronaut commentary and post-retrieval photos of the Long Duration Exposure Facility (LDEF) from the STS-32 Shuttle mission suggest that the condition of LDEF is about as NASA officials expected.

The objective of LDEF, which orbited Earth for nearly 6 years, was to measure the effects of atomic oxygen, space radiation, micrometeoroids, man-made debris, vacuum and other space-related phenomena on more than 10,000 test specimens. Some of those effects were immediately observable on LDEF during in-flight recovery operations.

Some thin film test specimens appeared to be degraded or completely eroded. Some thin film balloon material test specimens were broken away at one end. These are expected results that will be fully analyzed when the principal investigators have access to their LDEF experiments.

The Kapton thermal covers on two Heavy Ions in Space experiment trays were partially peeled back "like a sardine can" in the words of one astronaut. In addition, the thermal cover strips around the detectors of a space plasma high voltage drainage experiment appear to have eroded away. Impact on these experiments will not be known until researchers can examine them.

At least one of the thermal covers of an ultra-heavy cosmic ray nuclei experiment, located adjacent to LDEF's leading edge, exhibited more apparent debris or meteoroid impacts than anticipated but there probably was no effect on the cosmic ray data obtained. Investigators will pay particular attention to this area during post-flight examination of the satellite to determine the nature of the deterioration.

- more -

LDEF program officials also noted discoloration around the high voltage leads of an interstellar gas experiment. Just what this means will be studied in the data analyses that are the next step in the LDEF program.

Space Shuttle orbiter Columbia and LDEF are expected to arrive at Kennedy Space Center on January 26. The orbiter will be de-mated from the Boeing 747 Shuttle Carrier Aircraft and towed to the Orbiter Processing Facility (OPF) shortly thereafter. Current plans call for the removal of LDEF from Columbia's payload bay about January 29.

LDEF will be transferred to the Operation & Checkout (O&C) Building about January 30 and loaded onto a special transporter. Around January 31, the satellite will be moved to the Spacecraft Assembly and Encapsulation Facilty II (SAEF II) where researchers will inspect and photograph its structure and experiment trays from February 5 through 17. Program officials estimate that removal of the experiment trays will begin around February 22.

A meeting of the LDEF Investigator Working Group will take place at Langley Research Center, Hampton, Va., this summer on a date to be announced later. A press release summarizing the preliminary results will follow the meeting.

LDEF contains 57 science and technology experiments representing more than 200 investigators, 33 private companies, 21 universities, seven NASA centers, nine Department of Defense laboratories and eight foreign countries. Experiment analysis is expected to provide invaluable data for the design of future spacecraft as well as insight into Earth's cosmic origins.

- end -

Photographs are available to illustrate this release by calling NASA Headquarters Audio Visual Branch at 202/453-8375:

Color:	B&W:
90-HC-41	90-H-41
90-HC-42	90-H-42
90-HC-43	90-H-43
90-HC-44	90-H-44

NOTE TO EDITORS: Media representatives will have an opportunity to view LDEF's removal from Columbia about January 29 and may participate in an informal news briefing with LDEF Chief Scientist Bill Kinard at that time. Approximately 8 days later, there will another photo opportunity and a media briefing to discuss results of the initial LDEF inspections. The press conference will be carried live on NASA Select television. Media representatives wishing to participate in these events should contact the KSC Public Information Office, 407/867-2468.

NASA News

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For Release:
January 24, 1990

RELEASE: 90-12

PROPOSALS SOUGHT FOR SATELLITE SERVICER FLIGHT DEMONSTRATION

NASA's Johnson Space Center, Houston, has issued a call for proposals for requirement definition studies and preliminary design for a Satellite Servicer System flight demonstration.

The Satellite Servicer System flight demonstration will show the ability to maintain satellites in locations not readily accessible to humans (e.g., polar and high inclination orbits), to permit hazardous servicing, to reduce Space Transportation System extravehicular activity dependency and to improve cost efficiencies.

The system will be used in a three-phase, on-orbit flight demonstration launched from the Space Shuttle orbiter. The demonstration will exercise autonomous rendezvous and docking, orbital replacement unit exchange and fluid transfer capabilities, and will use existing technologies, including the Orbital Manuevering Vehicle and elements of the Flight Telerobotic Servicer, to minimize costs and reduce technical risks.

The flight demonstration Phase B studies, estimated at $1.3 million each, will include the design and definition of the servicer system, a target vehicle, and ground and on-orbit control stations. Two firm, fixed-price, Phase B contracts, with a 12-month period of performance, are expected to be awarded this summer. Responses to the request for proposals, released Jan. 19, are due March 5.

Phase B project managment resides at JSC's New Initiatives Office, Satellite Servicing Project Office.

- end -

NASA News

National Aeronautics and
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For Release:
January 25, 1990

RELEASE: 90-13

SCIENCE PAYLOAD COMMANDERS NAMED; CARTER REPLACES CLEAVE ON IML-1

In a move to provide long range leadership in the development and planning of payload crew science activities, four Space Shuttle mission specialists currently assigned to STS missions have been designated as payload commanders.

The payload commanders will have overall crew responsibility for the planning, integration and on-orbit coordination ofpayload/Space Shuttle activities on their mission. The crew commander will retain overall responsibility for mission success and safety of flight.

Named as payload commander for STS-42, the first flight of the International Microgravity Laboratory (IML-01) set for late 1990, is mission specialist Norman E. Thagard, M.D. In addition,

Navy Capt. Manley L. "Sonny" Carter, M.D., has been named as a mission specialist on the IML crew, replacing Mary L. Cleave, Ph.D., who has resigned her flight assignment for personal reasons.

Kathryn D. Sullivan, Ph.D., will serve as payload commander for STS-45, the first flight of the Atmospheric Laboratory for Applications and Science (ATLAS-01), slated for launch in 1991.

Payload commander for STS-46 is Jeffrey A. Hoffman, Ph.D. The STS-46 mission, set for 1991, will feature the first flights of the European Retrievable Carrier (EURECA), developed by the European Space Agency, and the Tethered Satellite System, a joint project between NASA and the Italian space agency, Agenzia Spaziale Italiana.

-more-

Air Force Lt. Col. Mark Lee will be the payload commander on mission STS-47 for Spacelab-J, a joint science venture between NASA and the Japanese National Space Development Agency, NASDA, also in 1991.

Future assignments of payload commanders normally will be made in advance of the remainder of the flight crew in order to help identify and resolve training issues and operational constraints prior to crew training.

The role of the payload commander also is expected to serve as a foundation for the development of a space station mission commander concept.

-end-

NASA News

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For Release:
January 26, 1990

N90-7

EDITORS NOTE: SPACE STATION EVOLUTION SYMPOSIUM SCHEDULED

A conference entitled "Space Station Evolution: Beyond the Baseline" will be held Feb. 6-8 at the South Shore Harbour Resort and Conference Center in League City, Texas, near the Johnson Space Center, Houston. Results of advanced systems studies and advanced development tasks within the Space Station Freedom program will be presented at the conference. News media are invited to attend the 3-day conference.

Among those scheduled to speak at the symposium are Richard H. Kohrs, Director, Space Station Freedom, and Dr. Aaron Cohen, Director of the NASA Johnson Space Center. Thomas Paine, former NASA Administrator and Head of the Presidential National Commission on Space that published "Pioneering the Space Frontier", will be the featured speaker at an evening banquet on Feb. 6. A complete listing of topics and times can be found in the enclosed brochure.

News media will not be charged a registration fee. However, they will have to pay for lodging and meals. Media representatives who wish to stay at the South Shore Resort are responsible for making their own lodging arrangements. The phone number for the hotel is 713/334-1000 and attendees are urged to call ahead and reserve a room at the $80 rate. Press who do not wish to stay overnight, but do plan to attend the banquet and luncheons, may pay for their meals in advance or when registering at the conference center. A registration form can be found on the back page of the brochure.

For more information, contact Carla Armstrong at the NASA Johnson Space Center, 713/483-9071.

- end -

NASA News

National Aeronautics and
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Ed Campion
Headquarters, Washington, D.C.
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For Release:
January 26, 1990
1:30 p.m. EST

RELEASE: 90-14

GLOBAL OUTPOST, INC., TO STUDY USES OF SHUTTLE EXTERNAL TANKS

The National Aeronautics and Space Administration (NASA) and Global Outpost, Inc., Alexandria, Va., today signed an agreement under which NASA will support Global Outpost's exploration of the feasibility of using Shuttle external tanks as research, storage or manufacturing facilities in low-Earth orbit.

Under the agreement, Global Outpost has the main responsibility to address the issues associated with their planned orbital use of external tanks. NASA's support of Global's efforts is on a direct cost, reimbursable basis.

The external tank is a structure (154-feet long, 28.6 feet in diameter) used to carry the 500,000 gallons of liquid hydrogen and oxygen used by the Space Shuttle main engines during launch and initial orbit insertion.

The agreement follows an announcement of opportunity NASA published in June 1988 which asked the private sector for expressions of interest in commercial and academic approaches for use of expended tanks. This activity is part of NASA's effort to seek and encourage, to the maximum extent possible, the fullest commercial use of space.

Copies of the agreement are available from the NASA Headquarters Newsroom at 202/453-8400.

- end -

NASA News

National Aeronautics and
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AC 202-453-8400

Mark Hess
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For Release:
January 29, 1990
1 P.M. EST

RELEASE: 90-15

NASA RELEASES JANUARY 1990 PAYLOAD FLIGHT ASSIGNMENTS MANIFEST

NASA today issued its January 1990 Payload Flight Assignments manifest for both the Space Shuttle and expendable launch vehicles (ELV). NASA plans 64 Space Shuttle and 30 ELVs missions through September 1995.

The most significant change to the manifest is the movement of the Gamma Ray Observatory from its June launch date into a November flight period aboard Atlantis. Ulysses, a joint ESA/NASA mission to send a spacecraft around the Sun's poles, must be launched during a 19-day launch window that opens Oct. 5, 1990, to avoid waiting 13 months before another launch opportunity opens.

On a calendar year basis, there are nine Space Shuttle launches planned in 1990, including STS-32 which was just completed, eight in 1991, 12 in 1992, 13 in 1993 and 11 in 1994 and 1995.

Remaining Shuttle launches in 1990 include a dedicated DOD mission aboard Atlantis on Feb. 22; launch of the Hubble Space Telescope aboard Discovery on April 18; the May 9 launch of Columbia with the Astro-1 payload; another dedicated DOD mission in July aboard Atlantis; the Spacelab Life Sciences-1 mission on Aug. 29 aboard Columbia; the Ulysses launch on Oct. 5; the Nov. 1 launch of Gamma Ray Observatory aboard Atlantis and the International Microgravity Laboratory flight on Dec. 12 aboard Columbia.

The 64 flights carried in the Shuttle manifest have Columbia and Discovery each making 16 missions, Atlantis flying 17 times, and Endeavour being launched 12 times. Six of Columbia's missions, beginning with the March launch of the U.S. Microgravity Laboratory-1 mission, will be extended duration, lasting 13 or 16 days.

- more -

The first flight of Orbiter Vehicle 105, Endeavour, will be February 1992 carrying the Geostar and Eureca spacecraft. First element launch of Space Station Freedom is carried on the manifest for March 1995 aboard Endeavour.

- end -

NASA News

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For Release:
January 30, 1990
10 A.M. EST

RELEASE: 90-16

INTERNATIONAL SPACE YEAR EDUCATION CONF. TO BE HELD IN FRANCE

The Centre National d'Etudes Spatiales (CNES), the French space agency will host an International Space Year (ISY) Education and Applications conference in Deauville, France, Feb. 12-15. The conference was organized in cooperation with NASA.

More than 120 education and training experts from around the world will attend the conference, which is being organized under the umbrella of the Space Agency Forum on ISY (SAFISY). Twenty-five national space agencies or equivalent bodies belong to SAFISY.

SAFISY was established at a conference hosted by NASA in 1988, following a proposal by Congress for an International Space Year in 1992 and its endorsement by the White House.

Deauville conference delegates will develop proposals for projects for the ISY in 1992 in the areas of education and applications. These proposals will be discussed at a SAFISY senior officials meeting in Japan next spring.

The Deauville conference also will establish an Education and Applications panel of experts that will advise SAFISY on a regular basis. Professor Jacques-Louis Lions, President of CNES, will serve as Chairman of the Deauville conference.

The conference will have two major programmatic themes:

--"Remote Sensing Training Applications" theme will focus on training projects of interest for developing nations in the areas of vegetation resources, natural hazards and urban and environmental planning.

--"Space and Education" theme will focus on educational initiatives in the areas of Earth observation, space science and space communications.

- more -

Earlier this year, SAFISY adopted 10 "mission to planet Earth" projects recommended by an Earth Science and Technology panel of experts established at a conference hosted by the British National Space Center. Those projects address the greenhouse effect, ozone depletion, deforestation and related environmental issues, as well as development of a Gobal Change Encyclopedia.

A third SAFISY experts panel, for space science, is being organized by the Committee on Space Research of the International Council of Scientific Unions.

- end -

(This news story is being simultaneously released with CNES)

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

For Release:

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Headquarters, Washington,D.C.
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February 2, 1990

Carter Dove
Goddard Space Flight Center, Greenbelt, Md.
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RELEASE: 90-19

GAMMA-RAY OBSERVATORY SET FOR SHIPMENT TO FLORIDA LAUNCH SITE

The Gamma-Ray Observatory (GRO), one of NASA'S Four Great Observatories, will be shipped Feb. 6 by builder TRW from its Redondo Beach, Calif., facility to Cape Canaveral Air Force Station (CCAFS), Fla., in preparation for Space Shuttle launch from Kennedy Space Center (KSC), Fla., in November 1990.

Following the Shuttle launch, GRO will be deployed into a near-circular orbit 279 miles from Earth, where it will gather gamma-ray data generated at the beginning of time -- perhaps 15 billion years ago -- in a comprehensive scientific effort to learn more about the origin and fate of the universe.

After shipment by a flatbed trailer-equipped truck from Redondo Beach to Los Angeles International Airport, the NASA satellite will be airlifted to CCAFS for further testing and eventual integration at KSC with Space Shuttle Atlantis.

The GRO will be the heaviest spacecraft ever deployed from the Space Shuttle, weighing nearly 17 tons. It is among the first spacecraft designed exclusively by computer techniques. Its four scientific instruments are the largest, most advanced and most sensitive of their type ever flown in space. They are designed to study gamma rays emitted by some of the most exotic and explosive objects in the universe. After an initial 2-year mission, the GRO may continue to function for 8 years or longer.

Completing the complement of NASA's Four Great Observatories are: the Hubble Space Telescope, scheduled for Space Shuttle Discovery launch from KSC April 18; the Advanced X-Ray Astrophysics Facility; and the Space Infrared Telescope Facility, the latter two planned for launch in the last half of the decade.

- end -

NASA News

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For Release:

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Headquarters, Washington, D.C.
(Phone: 202/453-8455)

February 1, 1990

RELEASE: 90-20

NEW DIRECTORS NAMED FOR INTERNATIONAL AND INDUSTRY RELATIONS

NASA announced today the appointments of Peter G. Smith to the position of Director, International Relations Division, and David L. Stottlemyer to the position of Director, Industry Relations Division.

Smith's appointment becomes effective Feb. 5, 1990. He will replace Richard J.H. Barnes who is retiring after 29 years of NASA service.

Stottlemyer was appointed to his postion Jan. 10, 1990, and replaces Carl F. Emde who is serving as special assistant to the Associate Administrator for External Relations.

Smith will be responsible for planning and directing NASA's international relations. Smith is currently Deputy Director of International Relations, a position he assumed in 1987. Previously, he was Chief of the International Program Policy Office in the International Affairs Division, which he joined in 1979. Before that, he was a foreign service officer and China specialist with the Department of State for 14 years, serving in Hong Kong, Seoul and Taipei.

Smith received a BS degree from Wesleyan University, Middletown, Conn., and did graduate work in Chinese studies at the University of Michigan. He also trained as an interpreter at the State Department's Chinese language school in Taichung, Taiwan.

Stottlemyer received a BA degree from Miami University, Ohio, and a master's degree in public and international affairs from the University of Pittsburgh. He also did doctoral work at the same university.

-more-

In 1964, Stottlemyer joined the federal government, initially with the Bureau of the Budget's International Programs Division. He entered the U.S. Foreign Service in 1971 and was assigned to the U.S. Mission to the United Nations in New York. Subsequently, he held a number of positions with the Department of State in Washington and in early 1981, joined the staff of then Vice-President George Bush. Stottlemyer returned to New York and the United Nations in 1984, serving as Director of Management and subsequently, as Director, Office of the Under-Secretary-General for Finance and Administration. He retired from the Foreign Service and the United Nations in 1987.

-end-

NASA News

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(Phone: 202/453-2927)

For Release:
February 5, 1990

3 P.M. EST

RELEASE: 90-21

NASA SELECTS SMALL BUSINESS INNOVATION RESEARCH PROJECTS

NASA announced today the selection of 28 research proposals for negotiation of Phase II contract awards in NASA's Small Business Innovation Research (SBIR) program. Included are 28 small, high technology firms located in 13 states.

This is the second group of selections made from a total of 203 proposals submitted by SBIR contractors completing Phase I projects. The 28 selections, valued at approximately $13 million, add to 84 Phase II selections announced on Dec. 1, 1989, bringing the total to 112 selections valued at approximately $54 million.

SBIR goals are to stimulate technological innovation, increase the use of small business (including minority and disadvantaged firms) in meeting federal research and development needs, and increase private sector commercialization of results of federally funded research.

Phase I project objectives are to determine feasibility of research innovations meeting agency needs. Phase II continues development of the most promising Phase I projects. Selection criteria include technical merit of the Phase I results and the proposed Phase II activity, the value to NASA and the capabilities of the proposing small firms. Phase II funding may be up to $500,000 over a period of 2 years.

SBIR projects are procured and managed by 9 NASA field centers. Overall program management is provided by the Office of Commercial Programs, NASA Headquarters, Washington, D.C.

- end -

(Editor's Note: A listing of the selected companies and their locations is available in the NASA Headquarters newsroom, 400 Maryland Ave., S.W., Washington, D.C. Phone: 202/453-8400 and at all NASA field center newsrooms.)

Posted: Sat, Feb 10, 1990 4:14 PM EST Msg: VJJA-2864-1878
From: PAO.KSC
To: L, PAO.LOOP
Subj: STS-36 LAUNCH ANNOUNCEMENT

1. Sylvia STSF
2. Bill
3. Sarah ST
4. Lee

Jim Cast Saturday, Feb. 10, 1990
Headquarters, Washington, D.C.
(phone: 202/453-8536)

Lisa Malone
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

Release No. 90-XX

LAUNCH DATE SET FOR STS-36

At the conclusion of today's Flight Readiness Reivew at NASA's Kennedy Space Center, Fla., Space Shuttle managers set a target date of February 22 for the launch of Atlantis on mission STS-36. The four-hour launch period for this classified Department of Defense mission is scheduled to extend from 12 a.m. to 4 a.m. EST.

At the present time, no significant problems stand in the way of launch on February 22.

# # # #

NASA News

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For Release:

Jeff Vincent
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February 12, 1990

RELEASE: 90-22

VICE PRESIDENT EMPHASIZES WHITE HOUSE SPACE COMMITMENT

Vice President Dan Quayle met today with NASA's senior management and gave the agency a resounding vote of confidence. Speaking at an informal luncheon at NASA Headquarters, Washington, D.C., the Vice President emphasized that the White House "is committed to making space a priority."

The Vice President told NASA officials that their immediate challenge is to "reignite interest and energy in the space program beyond the Beltway." He characterized the civil space program as being of "critical importance" to the nation.

Vice President Quayle is the Chairman of the National Space Council, which is charged with overseeing the President's national space policy and coordinating interagency space issues. He met with NASA Administrator Richard H. Truly, Deputy Administrator J. R. Thompson Jr. and the associate administrators who oversee the agency's various programs.

The Vice President discussed the value of new technology that flows from the space program and how it makes the United States more competitive in the world market. He also spoke at length on the link between NASA and education and, in particular, how the space program can inspire students to study science and math.

On January 26, the Administration announced it was seeking a 23 percent funding increase for NASA in FY 1991, the largest increase for any major agency. The President's budget message said that, "The exploration of space has benefits for the United States that go far beyond the quantifiable. There are specific payoffs in the form of new materials, technological discoveries and microgravity research. But no price can be put on the lifting of the spirit of people everywhere ... And no quantitative measure of any kind can capture the benefit of expanding human horizons, human dreams and the human domain."

- end -

NASA News

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For Release:
February 13, 1990

RELEASE: C90-f

TELEDYNE BROWN SELECTED PAYLOAD MISSION INTEGRATION CONTRACTOR

NASA's Marshall Space Flight Center, Huntsville, Ala., announced today selection of Teledyne Brown Engineering, Huntsville, for final negotiations leading to the award of a payload mission integration contract for the Marshall center. Estimated value of the contract is $172 million.

Teledyne Brown will provide management, personnel, equipment, services, supplies, facilities and materials required for the payload mission integration of the Shuttle/Spacelab missions, partial missions and mid-deck experiments assigned to Marshall during a 10-year period starting Oct. 1, 1990.

The procurement will include integration and analysis requirements; mission peculiar hardware and software; support to the physical integration, test and checkout of payloads with Spacelab and the National Space Transportation System and mission operations activity related to crew flight activities and ground-based operations support via the Marshall Payload Operations Control Center. The contractor also will refurbish selected elements of experimental hardware between flights, as required.

The Payload Operations Control Center is used for monitoring, coordinating and controlling on-orbit operations for Marshall-managed Spacelab payloads. The operations center also allows direct communication between science investigators on the ground and the Spacelab flight crew on orbit.

Spacelab is a unique laboratory facility. Carried in the cargo bay of the Space Shuttle orbiter, Spacelab converts the Shuttle into a versatile on-orbit research center.

- end -

NASA News

National Aeronautics and
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For Release:
February 13, 1990

Embargoed until 11 A.M. EST

RELEASE: 90-23

CLOSE-UP INSPECTION OF LONG DURATION EXPOSURE FACILITY BEGINS

NASA officials and principal scientific investigators making their first close inspection of the Long Duration Exposure Facility (LDEF) at Kennedy Space Center, Fla., report that the spacecraft looks much like they expected and hoped for after its extended stay in space.

LDEF's 57 experiments provide a unique opportunity to study significant long-term effects of spaceflight on a broad range of materials and components, as well as on living organisms. The spacecraft was retrieved by the crew of Space Shuttle Columbia on January 12.

LDEF's exterior shows obvious effects from nearly 6-years' exposure to bombardment by micrometeoroids and orbital debris, atomic oxygen impingement and the Sun's ultraviolet rays. LDEF will provide unprecedented data on the changes caused by the combination of these environmental parameters, because accurate simulations of the complex space environment are difficult to perform on Earth. These and other effects will be evaluated in detail once LDEF's experiments are removed for subsequent testing and analysis.

Discolorations or physical changes appear on many of LDEF's thermal control and optical surface experiments. There seems to be a significant contrast between the surfaces on the leading edge (facing the direction of flight) and those on the trailing edge. One major difference between these two sides of LDEF is the high exposure to atomic oxygen on the leading edge and very low exposure on the trailing edge. Many of the materials appear as expected for this extended exposure, while others look either more or less degraded compared to preflight estimates.

- more -

The Heavy Ions in Space (HIIS) experiment used plastic track detectors to measure the abundance of chemical elements in cosmic radiation. The experiment should offer new insights into the origin of chemical elements and may show how the elemental composition of the Solar System differs from that of the rest of the galaxy. The data also will improve our knowledge of radiation hazards faced by astronauts and by modern microelectronic components in space.

On seven of the eight HIIS modules, multilayer insulation thermal blankets partially detached and rolled up while LDEF was in orbit. The loss of temperature control and exposure of some of the detector material to direct sunlight probably resulted in some data loss. The thermal blanket on the eighth HIIS module is largely intact and may have preserved the data in that module.

Still another experiment, Space Exposed Experiment Developed for Students (SEEDS), looks good and all hardware is intact on the tray, suggesting that the seeds have been protected as planned. After preliminary growth tests, the 12.5 million tomato seeds that flew aboard LDEF will be distributed to U.S. students in grades 5 through university for use in classroom research.

Experiment trays will be removed from LDEF around February 22 and delivered to the principal investigators. By the end of April, all experiments should be in the hands of the investigators and analyses of the experiments underway.

Results from the LDEF mission will furnish invaluable data for design of future space structures, such as Space Station Freedom, as well as insight into Earth's cosmic origins.

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For Release:
February 14, 1990

RELEASE: 90-24

NASA ACQUIRES SUPERSONIC SR-71s ON LOAN FROM USAF

Three supersonic SR-71 "Blackbird" aircraft, being retired from the U.S. Air Force, are slated for loan to NASA's Ames-Dryden Flight Research Facility, Edwards, Calif. One airplane is scheduled for arrival on Feb. 15, with the second arriving Feb. 20. Arrangements for the third aircraft will be determined later.

The aircraft will be in flyable storage at the NASA facility until the Air Force determines that it no longer has a need to preserve them. NASA officials currently are assessing research opportunities and experimentation that can benefit from using these high-speed flying testbeds. A loan agreement between NASA and the Air Force for these aircraft is in preparation.

The Dryden facility operated YF-12s, similar to SR-71s, from 1969 to 1979, gaining much useful research data on structures and stability and control of airbreathing aircraft at high speeds and altitudes.

The SR-71, manufactured by Lockheed Corp., is capable of flying at greater than three times the speed of sound. The aircraft's 101-foot long titanium structure is coated with a special black paint that helps dissipate heat caused by high speeds.

-end-

Editors Note: Media wishing to photograph the arrival of the SR-71 on Feb. 15 or Feb. 20 should contact NASA Dryden Public Affairs at 805/258-3449 no later than 3 p.m. PST the day prior. NASA project official David Lux will be available for questions. Still photographs and videotape of arrivals will be available from NASA Dryden Public Affairs.

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For Release:

February 16, 1990

N 90-11
NOTE TO EDITORS:
ADMINISTRATOR TRULY TEACHES CLASS DURING NATIONAL ENGINEERS WEEK

NASA Administrator Richard H. Truly will become a teacher for a day and share his engineering and aerospace knowledge with Johnson Junior High School, located at Bruce and Robinson Sts., S.E., Washington, D.C.

During his February 20 classroom visit, Truly will talk about engineering's role in the exploration of space and will help students discover that math and science studies can turn ideas into reality. After the classroom visit, Truly will be available for media interviews at 2:45 p.m. in the school lobby.

Truly was one of a dozen distinguished engineers selected as an "All-Star" engineer by the National Engineers Week 1990 committee.

During the week of Feb. 18-24, more than 5,500 engineers will participate in the Discover(E) program by visiting junior high schools nationwide, reaching more than 500,000 students, to inspire them to study math and science. The Discover(E) program is a first-ever student outreach program conducted by and for the engineering profession.

- end -

NASA News

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N90-12

NASA ELECTRONIC INFORMATION ON COMPUSERVE AND GENIE

Beginning March 15, 1990, NASA news releases and other NASA information (press kits, mixed fleet manifests, fact sheets, etc.) will be available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange.

On the same date, NASA information on the Dialcom electronic service will be discontinued.

For current users of CompuServe, NASA information may be accessed by typing "Go NASA". For further information or a free introductory subscription to CompuServe, call 1-800-848-8199 and ask for representative 176.

For current users of GEnie, NASA information may be accessed by typing "NASA.NEWS". For further information or a free introductory subscription to GEnie, call 1-800-638-9636.

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For Release:
February 14, 1990

RELEASE: 90-25

TRULY PROMOTES SCIENCE AND MATH DURING NATIONAL ENGINEERS WEEK

NASA Administrator Richard H. Truly, selected as an "All-Star" engineer, will help launch National Engineers Week 1990 Discover(E) program by participating in a press conference on Tuesday, Feb. 20. Discover(E) is a first-ever student outreach program conducted by and for the engineering profession.

The kick-off press conference will be held at Jefferson Junior High School, 7th & H Sts., S.W., Washington, D.C., on Tuesday, Feb. 20, from 10:30 - 11:30 a.m. Also participating will be Stephen D. Bechtel, Chairman, Bechtel Group, Inc., and Honorary Chairman of National Engineers Week 1990 and Raul Allegre, place-kicker for the New York Giants. The three engineers will discuss their views of the future of the engineering profession and the U.S.'s ability to compete technologically.

During the press conference, results of a nationwide junior high school student survey about life in the 22nd Century will be released. The survey, conducted by the National Engineers Week Committee and "Science World," addresses questions like "Will Americans be living in space?" and "What will be the most common way to get rid of waste materials?"

During Engineers Week, Feb. 18-24, over 5,500 engineers will visit junior high schools nationwide, reaching more than 500,000 students, to inspire them to study math and science.

National Engineers Week is supported by a number of national engineering organizations to bring visibility to the profession. The event is celebrated during the week of George Washington's birthday. Washington was a military engineer and land surveyor responsible for establishing the first U.S. engineering school, which later became the U.S. Military Academy at West Point, N.Y.

Other All-Stars include, Astronaut Mary Cleave; Deputy Secretary of Commerce Thomas Murrin; Secretary of Energy James Watkins; National Science Foundation Director Erich Bloch; Chairman and CEO of Rockwell International Donald Beall; and Chairman and CEO of Amoco Corporation Richard Morrow.

- end -

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For Release:
February 20, 1990

RELEASE: 90-26

UCAR TO STUDY POSSIBLE USES OF EXTERNAL TANKS

The National Aeronautics and Space Administration (NASA) and the University Corporation for Atmospheric Research (UCAR), Boulder, Colo., have signed an agreement under which NASA will support UCAR's exploration of the feasibility of using Shuttle external tanks (ETs) as research, storage or manufacturing facilities in low-Earth orbit.

Under the agreement, UCAR has the main responsibility to address the issues associated with their planned orbital use of external tanks. NASA's support of UCAR's efforts is on a direct cost, reimbursable basis.

The ET is a structure (154 feet long, 28.6 feet in diameter) which is used to carry the 500,000 gallons of liquid hydrogen and oxygen used with the Space Shuttle main engines during launch and initial orbit insertion.

The agreement follows an announcement of opportunity NASA published in June 1988 which asked the private sector for expressions of interest in commercial and academic approaches for use of expended ETs. This activity is part of NASA's effort to seek and encourage, to the maximum extent possible, the fullest commercial use of space.

- end -

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For Release:
February 20, 1990

RELEASE: 90-27

ROSAT SPACECRAFT ARRIVES AT FLORIDA LAUNCH SITE

The ROSAT spacecraft, a German scientific satellite to be launched by NASA in early summer, arrived today at Cape Canaveral Air Force Station, Fla., after a flight from the Federal Republic of Germany (FRG) aboard a German 747 cargo plane.

ROSAT, which stands for Roentgen Satellite, will be launched using a Delta II rocket in late May or early June. Built by Dornier Systems of the FRG, ROSAT will perform the first all-sky survey with an imaging x-ray telescope. The survey will be followed by individual observations of x-ray sources. ROSAT is a cooperative project between NASA and the FRG's Federal Ministry for Research and Technology. The United Kingdom is cooperating on ROSAT through an agreement with the FRG.

The spacecraft is equipped with two imaging telescopes - a German Large X-Ray Telescope and a smaller extreme ultraviolet telescope known as the Wide Field Camera, contributed by the United Kingdom. A High Resolution Imager (HRI) on the Large X-Ray Telescope, was contributed by the United States. The HRI was built by the Smithsonian Astrophysical Observatory and is managed by NASA's Goddard Space Flight Center, Greenbelt, Md.

After the initial 6-month all-sky survey, ROSAT will be devoted to detailed observations of x-ray sources with observing time divided among investigators from the United States, the FRG and the United Kingdom.

The 5,000-pound satellite will be deployed into a 53-degree inclined, circular orbit 360 miles from Earth. ROSAT will be launched from Complex 17 at Cape Canaveral Air Force Station by the U.S. Air Force and a McDonnell Douglas launch team.

- more -

Final assembly and pre-launch testing of ROSAT's science instruments will be performed in the clean room at NASA's Hangar AE, Cape Canaveral Air Force Station.

Within NASA, the ROSAT program is managed by the Astrophysics Division of the Office of Space Science and Applications. NASA's Goddard Space Flight Center is responsible for detailed implementation of the ROSAT program.

- end -

NASA News

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For Release:
February 21, 1990

RELEASE: 90-28

ASTRONAUT MULLANE TO RETIRE FROM NASA, AIR FORCE

Effective July 1, 1990, Colonel Richard M. Mullane will retire from NASA and the Air Force.

Mullane was selected as a mission specialist astronaut in 1978 and has flown two Space Shuttle missions. His third flight is scheduled for launch Thursday aboard Atlantis.

He flew on Discovery's maiden flight, STS 41-D, in August 1984 and on the third flight of Atlantis, STS-27, in December 1988.

After leaving NASA and the Air Force, Mullane will return to his hometown of Albuquerque, N.M.

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For Release:
February 23, 1990

RELEASE: 90-29

PIONEER 11 PASSES NEPTUNE'S ORBIT, LEAVES SOLAR SYSTEM

Pioneer 11 today will cross the orbit of Neptune and become the fourth spacecraft to leave the solar system, providing a coda to humanity's first major planetary explorations. Pioneer 11 will join Pioneer 10 and Voyagers 1 and 2 in searching for the heliopause, the point at which the Sun's electromagnetic influence gives way to the galaxy's influence.

As it crosses Neptune's orbit, Pioneer 11 will be 2.8 billion miles from the Earth. Neptune's orbit currently marks one measure of the expanse of the solar system because, for the next 12 years, Pluto's eccentric orbit carries it inside Neptune's path. Some scientists refer to the heliopause as the edge of the solar system. By that definition, all four spacecraft are still within the solar system.

Launched in 1973, Pioneer 11 provided scientists with their closest view of Jupiter, passing within 26,600 miles of the cloud tops in December 1974. The close approach and the spacecraft's speed of 107,373 mph, by far the fastest speed ever reached by a man-made object, hurled Pioneer 1.5-billion miles across the solar system toward Saturn.

Before reaching Saturn in 1979, Pioneer 11 reached an inclination of 17 degrees above the solar equatorial plane, high enough to illuminate the true character of the sun's magnetic field. Now 780 million miles above the ecliptic plane where most of the planets orbit the sun, the spacecraft recently showed that many of the solar cosmic rays in the heliosphere originate outside the Sun's atmosphere in the interstellar gas, the space between the stars.

- more -

Pioneer 11 flew to within 13,000 miles of Saturn and took the first close-up pictures of the planet. Instruments located two previously undiscovered small moons and an additional ring, charted Saturn's magnetosphere and magnetic field and found its planet-size moon, Titan, to be too cold for life.

Pioneer 11, which will traverse interstellar space in the same direction as the Sun moves, continues to return good data, but in 3 years, operating the radio transmitter and scientific instruments simultaneously will be difficult, says NASA Project Manager Richard Fimmel. Technical adjustments may extend the craft's life through 1995. Pioneer 10, with a stronger power supply, may return data through the year 2000, which would extend its original 30-month design life to 28 years.

In June 1983, Pioneer 10 made history by becoming the first human artifact to leave the solar system, travelling in the direction opposite Pioneer 11's path. Today, Pioneer 10 will be 4.5 billion miles from Earth. Returning data to Earth at the speed of light requires 6 hours, 36 minutes. Pioneer 10 continues to search for the heliopause for very long-wavelength gravity waves that would further understanding of Einstein's Theory of Relativity and for evidence of a 10th planet.

The Pioneers are managed by the Ames Research Center, Mountain View, Calif., for NASA's Office of Space Science and Applications. The spacecraft were built by TRW Space & Technology Group, Redondo Beach, Calif.

- end -

NASA News

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For Release:
February 26, 1990

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RELEASE: 90-30a

COMPUTERIZED MEDICAL REFERENCE HAS SPACE AND EARTH APPLICATIONS

Three months and 6 million miles out from Earth, one of the Mars mission specialists tells you that his mild stomach discomfort has just turned into acute pain. As the spacecraft's physician, you've got to find out what's wrong, fast.

Since the problem could be one of hundreds of different things, from a gastrointestinal upset to internal hemorrhaging, you're faced with making a rapid and accurate diagnosis of a potentially life-threatening condition while alone in the vastness of space.

Fortunately, the solution to this spaceborne dilemma is here today, with applications that could change the way medicine is taught and practiced. It's a computerized medical reference system known as the Clinical Practice Library of Medicine, or CPLM.

The CPLM system was brought to life by a team of medical and computer experts from the University of Florida, Gainesville, and the Kennedy Space Center, Fla. These team members have worked together on the CPLM since 1979. Their efforts have turned the dreams of both a space scientist and a college physician into reality.

The space scientist is Dr. Paul Buchanan, Director of Kennedy Space Center's Office of Biomedical Operations and Research. He and his staff plan and research ways to develop life support systems for spacecraft crews. They have long considered a compact, lightweight and comprehensive medical reference a necessity for long-duration manned space missions such Space Station Freedom and deep space flights. Buchanan feels the system is vital because it frees the physician from his "umbilical" to Earth and allows him the capability for autonomous decision-making.

- more -

"The CPLM is one of those contributions that we think we can make to long-duration spaceflight," Buchanan points out. "This system is a part of what our office is all about, trying to keep man in space to stay and developing ways he can support himself in that environment."

The college physician is Dr. Ralph Grams, a pathologist at the University of Florida's College of Medicine. He heads up the university's CPLM software development team. His dream began while trying to memorize the thousands of medical terms and symptoms that a student must learn and a physician must know before they can become successful in the medical field.

"I thought that the best way to solve the medical information overload was to devise a computerized biomedical library," says Grams. "With this system, references could be looked up rapidly on a display screen rather than a textbook. The considerable amount of time normally spent digging through library stacks could be more profitably used in direct patient care."

This same desire to provide a rapid reference to medical conditions has been behind the university's work with Buchanan's office for the past 10 years. Both Grams and Buchanan wanted a system that would provide the spacecraft physician with nearly instantaneous access to the most complete medical references on Earth while millions of miles away from the home planet. With such a diagnostic decision support system, the physician could be confident that he or she was making the right diagnosis.

The CPLM team believes the system to be the first general computer-based medical reference of its kind. Grams and Buchanan also feel that CPLM has considerable potential for down-to-Earth uses -- in doctor's offices, university clinics and on U.S. Navy ships.

"Our system had to be compact and lightweight, with high-speed access to its database," Buchanan says. "These features make it a natural for use in Earth-bound applications."

The CPLM system is compact enough to sit on a Space Station Freedom workstation desk. It is made up of a personal computer, high-resolution color graphics monitor and a 300-megabyte hard drive. Loaded in the drive is a program that contains nearly all the text and graphics of seven of the reference books that the medical profession considers to be its diagnostic "bibles." They include the "Merck Manual," "Principles of Internal Medicine" and five others.

Compare the CPLM system's size and weight with the medical texts themselves and you can see why NASA did not even begin to consider carrying these publications into space. This 2-foot stack of references weighs over 20 pounds and consists of about 15,000 pages of text and over 500 full-color drawings.

This number of pages would be hard enough to reference by hand with one indexing system. Each printed reference has its own complicated and non-standard means of referring to its data. So trying to find the suspected medical condition, based on a few symptoms in the traditional page-turning and paper-clipping manner, becomes a difficult and time-consuming process.

However, no physician can be without such references, especially if he or she is not seeing patients on a regular basis, Buchanan says. "You simply cannot practice medicine without a medical reference," Buchanan says. "In my experience, the first things to go after long periods without a clinical situation are you lose touch with your medical knowledge and the ability to create a good diferential diagnosis -- it's a kind of use-it-or-lose-it type of situation. So you have to have a ready source of information to jog your memory if you expect to make an accurate diagnosis."

A major function of the CPLM is to spark the physician's memory, Grams says. But since its electronic storage and retrieval capacity far exceeds the medical information a doctor's grey matter can recall, he also sees the system as being the basis for a revolution in medical education.

"We could train medical students to solve diagnostic problems with access to a whole computerized spectrum of knowledge instead of teaching them to rely on just what's in their heads," Grams says. "This approach could change the whole course of medical education. However, we first need to have physicians accept the CPLM as a diagnostic decision support system."

To gain this acceptance, Grams' team wrote the CPLM software to appear and function just like a book in a library. Grams tells first-time users to compare the CPLM with a librarian who does reference searches for them.

The opening screen of the CPLM program shows a drawing of the references on a bookshelf. To refer to one of the documents, the user simply moves the computer cursor to one of the simulated books and hits the return key. A full document search can be initiated by centering on another icon.

The actual search to identify the suspected disease or condition employs a logical approach familiar to most physicians. It's called the Boolian construct method and it is the ideal way to make a diagnosis, Buchanan says. It's also a tool used in writing computer programs.

Through a series of prompts, the CPLM system directs the doctor to establish the facts, or what he knows about the patient, such as sex, age and race. The variables are the patient's symptoms, such as lower abdominal pain. The symptoms are added to the inquiry by an OR or AND statement. Since the system can interpret segmented statements in English, a typical inquiry might be MALE, AND ABDOMINAL PAIN, AND VOMITING AND FEVER.

Setting up the inquiry statement establishes the combination of key words that the CPLM system will use to scan all of the references, Grams explains. The system first looks into the dictionary and thesaurus included in its memory for each reference to find similar words. It then displays a list of possible medical conditions to fit these symptoms.

"When the reference comes up on the screen, the user will see it just as he would if he were to look it up in the book," Grams says. "The quality of the graphics in the CPLM program is so good that you really can't tell them from the printed pages. In fact, it's better, because the program has a zoom feature that enlarges the drawings when you really need to look closely at a cell structure, for example."

A text highlighting system also provides an advantage over the printed page, Grams adds. The key words in the reference appear in red, while the sentence the word is found in is highlighted in yellow. The yellow looks like ink from a highlighter pen, so the page is identical to one that a reader might mark up.

As with the printed page, the highlighting makes it easy for the physician to read the reference quickly to see if it is the right one. If it's not, he "turns" to a another reference by hitting a key.

Once displayed on the screen, the references can be listed on the screen, with the ones that contain the most data about a medical condition listed first. The text reference is analyzed by word frequency to show the disease with the highest number of word references. This feature makes finding the medical condition that fits the patient's symptoms a more rapid process, Grams says. "Now it usually only takes one or two inquiries to get the right diagnosis," he emphasizes.

All the elements of the CPLM program are designed to help medical personnel make an accurate diagnosis, but speed is the system's attribute that will make it popular with users, Grams says.

"With the CPLM system, the physician can take the time to refer to medical texts, since doing so on this system takes only a few seconds", says Dr. Albert Koller Jr., Chief of Programs and Planning for Buchanan's office. "Normally, a physician just does not have the hours and possibly days that a manual literature search would take to find the suspected medical condition."

By encouraging a reference search for each case, the CPLM system also could prove to be a lifesaver, Koller emphasizes.

"The CPLM system can provide references to conditions that are perhaps outside the knowledge and experience of a certain physician," Koller explains. "Even though the physician might not have considered this condition, the CPLM's reference to it could be the key to saving the patient's life."

"A particular skin condition also might be something a doctor has not seen before," Koller adds. "When the CPLM displays the graphics for this condition on the computer monitor, he will actually see it as he would in a photograph printed in a medical reference." In doing so, the CPLM system is helping to educate the doctor at the same time it is helping him make the right diagnosis.

The CPLM system also can be an excellent tool for medical students or physicians who want to update their medical knowledge in the most efficient fashion, Buchanan points out. "The educational capability of the CPLM system may be one of its major benefits -- not only for the space program, but also for the terrestrial physician, nurse or physician's assistant as well," he stresses.

One of the educational gaps CPLM can fill is that of keeping physicians up to date on current medical practices, Grams says. A major problem for physicians is the volume of material they must read about new techniques and treatments. Compounding this problem is the fact that it's often a period of 3 to 5 years between printed medical reference revisions.

"With the CPLM system, we could supply computer disks that would contain the updates," Grams says. "CPLM system owners could load these disks and have the information available for use in diagnostic situations immediately. The physican also could study the updates at his leisure."

Additional references also can be added to the CPLM database. Currently, the eighth reference, an emergency medical procedures manual, is being coded into the CPLM computer language so that it can work with the rest of the references, Grams says. The software development work has been conducted at the University of Florida.

"There really is no limit to the number of references we can add to the system," says Grams. "There's plenty of room in the hard disk we're using now. We also can increase the size of the storage unit without slowing down the CPLM's operating speed."

Other future possibilities for the system include adding voice activation and interactive hardware, adds Koller. With these features, the CPLM could become a fully automated physician's assistant. While the physician performs a minor operation, he could verbally instruct the CPLM to bring up a reference on the screen. Then the system could either display the information or read the text aloud to the doctor.

Grams sees even further potential for the CPLM system that directly relates to the space program. He envisions space suits with the CPLM system built in so that medical assistance could be given anywhere in space. Another application would be a hand-held portable CPLM unit that would fit into a physician's black bag and supply him with his own library of medical knowledge anywhere he went. The technology for the hand-held CPLM could be here within 3 to 5 years, Grams says.

Before any future CPLM derivatives can be built, however, the present CPLM system must be clinically tested, Buchanan says. The first phase will begin in 1990, where it will be used in several university clinics for about a year to see how well the system performs in the real world.

"The U.S. Navy has just agreed to have several CPLM units installed on aircraft carriers and submarines," Buchanan points out. "Corpsmen and other medical personnel on these vessels will be field testing this system for us," he continues.

A shipboard environment would be an excellent testing ground for the CPLM system, since it is similar to that of a spaceship. Both vehicles are isolated from communication and must operate autonomously, the system's developers emphasize. In this situation, the system would also be used by medical personnel who are not trained physicians, a situation that could arise in a spacecraft emergency.

Regardless of the setting, there's a feeling at the University of Florida and the Kennedy Space Center that the CPLM system will come through its clinical tests with flying colors. Grams has been testing the system himself at the College of Medicine and has seen suprisingly favorable diagnostic accuracy. Medical students at the University of Florida clinic have also been working with CPLM in parallel with traditional methods, Grams says.

NASA's Buchanan and Koller also feel that this space program spinoff will prove itself and become a readily accepted diagnostic tool in the near future.

"The fact that a system we designed for space has major spinoff possibilities in medical education was obvious from the beginning," Buchanan says. "It's a neat feeling when you get something developed that you really consider essential for space and you see the spinoff value. Then you know you have something that you really have to hang on to."

- end -

NOTE: Photographs illustrating this release are available from NASA Headquarters' audiovisual office, phone 202/453-8373:

Photo Numbers:
B & W - 90-H-73, 90-H-74, 90-H-75, 90-H-76, 90-H-77
Color - 90-HC-71, 90-HC-72, 90-HC-73, 90-HC-74, 90-HC-75

Beginning March 15, 1990, NASA news releases and other NASA information is available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. On the same date, NASA information on the Dialcom electronic service will be discontinued. For information on CompuServe, call 1-800-848-8199 and ask for representative 176. For information on GEnie, call 1-800-638-9636.

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Johnson Space Center, Houston
(Phone: 713/483-5111)

For Release:
February 26, 1990
3 p.m. EST

RELEASE: 90-31

VETERAN SHUTTLE ASTRONAUT WILLIAMS TO RETIRE FROM NASA, NAVY

Navy Capt. Donald E. Williams, veteran of two Shuttle flights, will retire from NASA and the Navy, effective March 1, to pursue a career in private industry.

"I reached my goal as a pilot, which was to command a mission," said Williams. "Now it's time to go on to other challenges. JSC and NASA have been a wonderful place to work and I'm proud to have been a part of the team."

Williams was selected by NASA as an astronaut in 1978 and made his first space flight in April 1985 as pilot of Discovery on mission STS-51D, which included the first unscheduled rendezvous and spacewalk. He flew again as crew commander of Atlantis in October 1989 on mission STS-34, highlighted by the deployment of the Jupiter probe, Galileo.

Prior to STS-34, Williams served as Chief of the Astronaut Office Mission Support Branch. He also served as Deputy Manager of Operations Integration in the NSTS Program Office and as Deputy Chief, Aircraft Operations Division during his years with NASA.

Williams will be joining Science Applications International Corporation in Houston as Senior Systems Engineer.

- end -

Beginning March 15, 1990, NASA news releases and other NASA information will be available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. On the same date, NASA information on the Dialcom electronic service will be discontinued. For information on CompuServe, call 1-800-848-8199 and ask for representative 176. For information on GEnie, call 1-800-638-9636.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

David W. Garrett
Headquarters, Washington, D.C.
(Phone: 202/453-8400)

For Release:
February 28, 1990
3:00 P.M. EST

RELEASE: 90-32

AERONAUTICS/EXPLORATION/TECHNOLOGY OFFICES MERGER COMPLETED

NASA Administrator Richard H. Truly announced today the creation of the Office of Aeronautics, Exploration and Technology (OAET). This formalizes the merger of two previous NASA offices, the Office of Aeronautics and Space Technology and the Office of Exploration.

On Dec. 21, 1989, Truly stated his intention to merge the two offices in order to continue the analysis of exploration mission alternatives and to begin the actual pursuit of innovative technologies. At that time, he said the two efforts were closely related and that they should proceed under a strong central management. Also, he emphasized that in no way would the consolidation of the two offices diminish the agency's dedication to aeronautical research.

The OAET will be headed by NASA Associate Administrator Arnold D. Aldrich.

In approving the consolidation, Truly said, "This office will provide the planning, direction and technology, as well as manage the assessment of concepts and technology for human exploration beyond Earth orbit into the solar system. I view this as a major step in streamlining the management arrangement that will combine cutting-edge technologies with studies of future space and aeronautics missions."

- end -

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NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

For Release:

Jeff Vincent
Headquarters, Washington, D.C.
(Phone: 202/453-8369)

3:00 p.m. EST
February 28, 1990

RELEASE: 90-33

MARTY KRESS TO HEAD NEWLY ORGANIZED LEGISLATIVE AFFAIRS OFFICE

NASA Administrator Richard H. Truly today announced the establishment, effective March 18, 1990, of the Office of Legislative Affairs and the appointment of Martin P. Kress as the Acting Assistant Administrator for Legislative Affairs. The newly named office will report directly to the NASA Administrator and be responsible for legislative matters and the coordination of budgetary and policy matters with Congress.

"The elevation of this organization reflects the significance of its work and the importance of maintaining excellent communications with Capitol Hill," Truly said. "Marty Kress brings to this job both a wealth of direct experience in congressional affairs and a solid knowledge of the civil space program. He will be a real asset to NASA, and I'm delighted that he will be joining us."

Kress is currently a senior professional staff member of the Senate Subcommittee on Science, Technology and Space, a position he has held since 1984. His 11 years of Senate staff experience also include assignments with the Subcommittee on Business, Trade and Tourism and the Committee on the Budget. Earlier, Kress worked as a staffer for the Massachusetts League of Cities and Towns and for the Massachusetts Office of Federal-State Relations.

Kress received a bachelor of arts degree from the University of Notre Dame in 1970, and a master's degree in public administration from Northeastern University in 1974. He also has done work toward a Ph.D. at Georgetown University. He was born in Syracuse, N.Y., and now lives in Vienna, Va.

- end -

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Randee Exler
Goddard Space Flight Center, Greenbelt, Md.
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For Release:
March 1, 1990

RELEASE: 90-34

ASTRONOMICAL TELESCOPES FOR NASA SPACECRAFT ARRIVE AT GODDARD

The astronomical telescopes for NASA's Extreme Ultraviolet Explorer spacecraft have been delivered to the Goddard Space Flight Center (GSFC), Greenbelt, Md., for integration into the Goddard-designed payload module and for subsequent environmental testing.

The scientific payload consists of four specially designed telescopes that will make astronomical observations in the previously unexplored portion of the electromagnetic spectrum called the extreme ultraviolet, which is between the X-ray and ultraviolet wavelengths.

The integration and testing of the spacecraft at Goddard, which includes mating the payload module to NASA's Explorer platform spacecraft bus, is expected to take 18 months. The payload will be launched into low-Earth orbit aboard a Delta II expendable launch vehicle from Cape Canaveral Air Force Station, Fla., in August 1991.

During its expected 2-year mission, the explorer spacecraft will carry out an all-sky survey in the 100 to 1,000 angstrom wavelength region and will subsequently include a program in which guest investigators will be able to conduct spectroscoptic observations of the brightest extreme ultraviolet celestial sources.

The spacecraft's science payload has been designed, built and tested by the Space Astrophysics Group of the Space Sciences Laboratory, University of California, Berkeley. Professor Stuart Bowyer is the principal investigator. Dr. Roger F. Malina is the principal investigator for the construction of the telescopes. The project manager at Berkeley is Steven J. Battel.

- more -

The science operations center for the telescopes will be located at the University of California, Berkeley's Center for Extreme Ultraviolet Astrophysics. The payload operations control center will be located at Goddard where Donald L. Margolies is the spacecraft's mission manager.

- end -

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For Release:
March 1, 1990

RELEASE: 90-35

NASA'S FIRST 'A' MARKS 75 YEARS OF ACHIEVEMENT

With just a $5,000 initial outlay 75 years ago on March 3, 1915, Congress established the National Advisory Committee for Aeronautics (NACA), which would in 1958 form the foundation for the National Aeronautics and Space Administration (NASA). Even today that first small investment -- made only a dozen years after Orville Wright's famous flight -- is still paying enormous dividends.

Although the United States could claim the first heavier-than-air flight by the Wright brothers in 1903, American aviation had been surpassed by European technology at the outbreak of World War I, and no American-designed aircraft flew in combat. The NACA was created to help regain the nation's position of aeronautical preeminence.

From its beginnings as a simple government entity, NACA grew into the world's premier aeronautical research organization, pushing back the frontiers of flight for more than 4 decades. Aviation pioneers such as Wright, Jimmy Doolittle, Charles Lindbergh and Eddie Rickenbacker were among the early NACA members.

The 1915 law directed NACA to "supervise and direct the study of the problems of flight, with a view to their practical solution." The committee also was to facilitate the exchange of information within the aeronautical community.

At that time, the United States had virtually no aeronautical engineers. NACA focused American scientific, technological and industrial talent on the potential of aircraft, and in effect, created the academic discipline of aeronautical engineering and its related fields.

- more -

Though NACA was begun later than similar European efforts, it eventually put the United States in the lead in aviation. Today, three-quarters of a century later, NASA scientists and engineers continue to solve the problems of flight, both in and beyond Earth's atmosphere. But it was NACA that first built key facilities and devised organizational methods for advancing what is now called aerospace technology.

The practical-minded engineers and scientists of NACA incubated the ideas and hatched the technology that first allowed American aviation to take off and fly. The returns on the nation's investment in NACA remain clearly visible today in numerous ways.

By recognizing the needs of manufacturers and the military, NACA contributed extensively to every generation of commercial, civilian and military aircraft and developed the foundations for the modern aviation and space industries. The economic benefits of this long-term American competitiveness are a particularly clear part of the NACA legacy. In 1989, for instance, the U.S. aerospace industry saw a trade surplus of some $18 billion.

Facilities for Aeronautical Research

The inception and subsequent major periods of growth for the NACA were spurred by some of the century's major historical events. World War I demonstrated the military value of aircraft. Charles A. Lindbergh's 1927 solo Atlantic crossing caught the world's imagination. World War II required massive research and development in aviation, as did the events of the decades that followed.

The growth spurred by these events was evident in another visible aspect of the NACA legacy: research facilities.

By the early 1920s, aeronautical research had begun in earnest at NACA's Langley Memorial Aeronautical Laboratory, Hampton, Va., Hampton, Va., whose personnel formed the nucleus for two newer laboratories. On the eve of World War II, Ames Aeronautical Laboratory was begun in Mountain View, Calif., and the Aircraft Engine Research Laboratory began operations in Cleveland. These three NACA laboratories are now known as NASA Langley, Ames, and Lewis Research Centers, respectively.

The challenge for NACA researchers in the 1920s was to improve virtually every characteristic of aircraft. The struts and wire braces of biplanes caused severe, speed-reducing drag. The planes had poor lift-to-drag ratios, bad propellers and underpowered, unreliable engines. Basic understanding of the principles of flight was limited.

The primary research tool for overcoming these problems was the wind tunnel. NACA's first wind tunnel was dedicated at Langley in 1920.

Since that time, aerospace researchers have used wind tunnels to test their ideas. By moving an airstream across an aircraft, component or model, they can gather test data reliably, inexpensively and safely.

NACA's first Full-Scale Tunnel was built after NACA had risen to international aviation research preeminence during the 1920s. By the end of that decade, NACA's work had pointed the way for aircraft to evolve toward the basic aerodynamic shapes still seen today.

The first Full-Scale Tunnel began as one of a trio of innovative tunnels. Later, it was the center of the World War II effort to speed up military planes by finding ways to reduce their aerodynamic drag -- an effort that contributed substantially to Allied air power.

In 1990, this same tunnel is about to enter its 7th decade of churning out valuable aerodynamic data. As one of scores of American tunnels conducting research into every kind of flight, including flight through and out of Earth's atmosphere, tunnels are used in studies of military, general aviation and commuter aircraft. In fact, this circa-1930 facility has a backlog of demand and is staffed for double shifts.

Another example of the NACA legacy in research tools -- and therefore also of continuing returns on original investments in the organization -- is the world's largest wind tunnel located at Ames Research Center. The tunnel's largest test section was 40 feet by 80 feet.

This facility was built during World War II and could test a complete fighter plane with its engine running. The tunnel was still the world's largest in 1987 when its size was increased to 80 by 120 feet and the power of its huge fans was nearly quadrupled. It now can accommodate even larger aircraft.

A supersonic tunnel at Lewis, built in the early 1950's , tackled the special problems of testing full-scale jet and rocket engines. The tunnel, which is still in use, has been used for a wide range of aircraft, airbreathing missiles and manned spacecraft tests.

Wind tunnels today still constitute a large part of the American investment in aeronautical research tools. In 1988, a special committee of the National Research Council valued the combined replacement cost of American tunnels in the billions of dollars and wrote that the health of these facilities is integrally linked with the health of the entire national aeronautical development effort. The research heritage of wind tunnels -- and many of the tunnels themselves -- come from the NACA era.

NACA Achievements

NACA/NASA innovations won six Collier trophies, America's most prestigious aviation award, for outstanding contributions to aeronautics technology. In innumerable other instances, NACA contributions paved the way for other immediate or longer-term improvements in aircraft. By the post-World War II era, the work of NACA even began paving the way toward the Space Age.

The first Collier Trophy was given in 1929 for the innovative NACA cowling, which was placed around the radial air-cooled engine of the day to reduce drag while allowing the needed cooling. In 1946, NACA won the Collier Trophy for developing a thermal ice-prevention system for aircraft.

After World War II, NACA began extensive work in jet engine research, and led advances in high-speed aerodynamics with programs like the X-1, in which Chuck Yeager surpassed the speed of sound in 1947, and the X-15, the first winged vehicle to fly into space. The 1947 X-1 flight led to NACA's third Collier Trophy in 1948.

NACA's fourth and fifth Collier trophies came in 1951 and 1955. One was for a wind-tunnel technology innovation called the slotted throat, which enabled tunnels to simulate the conditions of transonic flight or flight near and exceeding the speed of sound. The other was for the transonic "area rule," a principle of aerodynamic shaping that greatly enhanced the designs of supersonic aircraft.

Building on NACA's proud heritage, NASA was awarded a sixth Collier trophy in 1987 for developing the technology for and testing of advanced turboprop propulsion systems that offer dramatic reduction in fuel usage for future subsonic transport aircraft.

The NACA research tradition lent itself well to work on concepts for aerospace craft that would need to return to Earth from orbit or from spaceflight. Many NACA researchers worked years ahead of existing technology in the post-World War II era, much as NASA researchers often do today. They established the fundamental atmospheric re-entry during these pre-NASA years.

75 Years of Returns on Investment

As the world's premier organization for aeronautical research, NACA provided the foundation -- the people, the institutions, the research tools -- on which NASA and the American aerospace industry have been built. The extent of the NACA-era legacy to NASA and to the nation shines through in a recent celebration of engineering achievements by the National Academy of Engineering.

The academy cited NASA's Apollo moon landing as one of the greatest engineering achievements of all time and listed nine other achievements as the greatest of the past quarter-century. In addition to Apollo, three of these nine involve some large degree of NASA contribution: unmanned satellites, advanced composite materials and the jumbo jet. Four other cited achievements fall within the sphere of daily activity throughout NASA: micro-processors, computer-aided design, lasers and fiber-optic communication.

Even after 75 years, that first $5,000 appropriated by Congress in 1915 is still paying off throughout the American economy and in NASA -- a scientific and technological organization that spurs American competitiveness, spans the continent and reaches for the heavens.

- end -

Photographs are available to support this release. Requests should be made to NASA Broadcast and Audio visual, 202/453-8383.

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NASA News

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For Release:
March 2, 1990

RELEASE: N90-13

EDITORS NOTE: HST, STS-31 MISSION AND CREW BRIEFINGS SET

A series of background briefings on the Hubble Space Telescope, the deployment mission, secondary payloads and the astronaut pre-flight press conference for Space Shuttle mission STS-31, now set for launch on April 12, will be held March 15 and 16 at the NASA Goddard Space Flight Center, Greenbelt, Md., and March 19 and 20 at the NASA Johnson Space Center, Houston.

The briefing schedule follows (all times Eastern Standard):

- Thursday, March 15, Goddard Visitor Center

  9 a.m. Hubble Space Telescope Science
  12 p.m. Preparations, deploy, verification, servicing
  5 p.m. "How to cover mission" briefing

- Friday, March 16, Goddard and Space Telescope Science Institute, Baltimore

  10 a.m. and 2 p.m. Press tours of HST control facilities (Goddard) or HST science operations areas (Institute)

-more-

o Monday, March 19, Johnson Space Center

9:30 a.m.	STS-31 Flight Director mission overview
10:30 a.m.	Secondary, middeck and student experiments
11:30 a.m.	Flight Crew Press Conference
	(Followed by round -robin media interviews)

Briefings will be carried live on NASA Select television, available on Satcom F2R, transponder 13 at 3960 MHz. Two-way question and answer capability will be available at other NASA centers and at Headquarters.

During the mission, media wishing to focus attention on the Hubble Space Telescope activities are advised to contact Goddard Public Affairs, 301/286-5565, to arrange for accreditation at the Goddard News Center. Goddard will operate a 24-hour-a-day newsroom during the mission and will have telescope scientists and managers available for briefings and interviews.

- end -

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For Release:
March 6, 1990

RELEASE: N90-14

EDITORS NOTE: NASA HOSTS 21ST LUNAR/PLANETARY SCIENCE CONFERENCE

Some 750 scientists from around the world are expected to attend the 21st Lunar and Planetary Science Conference, March 12-16, at the Johnson Space Center, Houston.

Scientists and scholars will present approximately 375 papers covering such subjects as a Venus overview prior to Magellan; lunar meteorites, geology and resource utilization; cosmic rays; comets and orbital dust collection; the outer solar system; Martian geophysical and tectonic evolution, volcanic evolution, climate histories and craters; solar nebula and planetary origins; heavy metal meteorites; Triton and Phobos and planetary geological processes.

There will be two public sessions including a March 12 discussion of President Bush's Moon/Mars exploration initiative featuring JSC Director Aaron Cohen and a March 14 special Voyager 2 session featuring the California Institute of Technology's Andrew Ingersoll. The Voyager 2 spacecraft in August 1989 sent back data and images of Neptune. Both programs will begin at 8 p.m. in Teague auditorium in Bldg. 2 and are free of charge.

An 8:30 a.m., March 14 technical session will feature discussions on interplanetary dust and LDEF findings.

Concurrent sessions are scheduled each day at 8:30 a.m. and 1:30 p.m. On March 16, sessions are scheduled for 8:30 a.m. and 10:15 a.m. in the JSC Gilruth Center.

Media interested in covering the conference should register in the Gilruth Center, Room 216, from 8 a.m. to 5 p.m. March 12-15 or in the morning of March 16. Conference abstract volumes of several scientists' papers will be available at the Gilruth Center or on request from JSC's newsroom. All times are CST.

- end -

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Ames Research Center, Mountain View, Calif.
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For Release:
March 6, 1990

RELEASE: 90-36

PETERSON NAMED DEPUTY DIRECTOR OF AMES RESEARCH CENTER

Dr. Dale L. Compton, Director of NASA's Ames Research Center, Mountain View, Calif., today named Victor L. Peterson, Deputy Director of the Center.

Peterson, 55, has served as Ames' Director of Aerophysics from 1984 and as the Center's Acting Deputy Director since 1988. He has held various positions at Ames, including Research Scientist, Chief of the Aerodynamics Branch and Chief of the Thermo and Gas Dynamics Division. He was one of the originators of the NASA initiative to develop the Numerical Aerodynamic Simulation System, the leading computational resource for the nation's aerospace program.

Peterson joined Ames in 1956 after receiving a bachelor's degree in aeronautical engineering from Oregon State University. He also holds a master's degree in aeronautics and astronautics sciences from Stanford University and a master's degree in management from the Massachusetts Institute of Technology, where he was an Alfred P. Sloan Fellow.

Peterson has served on many national boards and committees, including a National Science Foundation committee chartered to assist with the creation of national supercomputer centers at several universities. He has written about 50 technical papers and reports in the fields of fluid and flight mechanics and on the use of supercomputers in science and engineering. He was awarded the NASA Outstanding Leadership Medal in 1984 and was elected a Fellow of the American Institute of Aeronautics and Astronautics in 1986.

- more -

A native of Saskatoon, Saskatchewan, Canada, Peterson and his wife, Jacqueline Dianne, reside in Los Altos, Calif. They have three children.

- end -

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For Release:
March 9, 1990
Noon EST

RELEASE: 90-37

NASA REVISES SPACE SHUTTLE MANIFEST

NASA has revised its January 1990 Space Shuttle Manifest, changing the planned launch dates for several NASA, international and Department of Defense (DOD) payloads.

Most of the changes to the manifest were a result of advancing the DOD's mixed cargo flight -- the Infrared Background Signature Survey/Air Force Program-675/Space Test Program/Multi-Purpose Experiment Canister (STS-51) -- from January 1992 to January 1991. The mission will be renamed STS-39. The payload previously in the January 1991 slot, Tracking and Data Relay Satellite-E (STS-43), has been moved to May 1991.

STS-46, a NASA mixed cargo mission including the first flight of the NASA/Italian Space Agency's Tethered Satellite System, the European Space Agency's European Retrievable Carrier, the Evaluation of Oxygen Interaction with Materials and the Two-Phased Experiment Mounting Plate, was moved from May 1991 to September 1991. DOD's STARLAB mission, scheduled for September 1991, has been delayed to January 1992.

Other manifest changes include the addition of the Shuttle Solar Backscatter Ultra-Violet Instrument payload (SSBUV) to both the Ulysses and TDRS-E missions. SSBUV has been removed from STS-37, scheduled for November 1, 1990, aboard Atlantis, which will deploy the Gamma Ray Observatory into orbit. Also, the Space Radar Laboratory series of missions has been delayed about one year.

Additional changes to the Mixed Fleet Manifest beyond the January 1992 launch of STARLAB are under review. NASA plans to issue a new manifest in June.

- end -

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For Release:

March 14, 1990

N90-15

EDITOR'S NOTE: NASA TO DEBUT FIRST MOBILE TEACHER RESOURCE CENTER

News media are invited to a public ceremony, Friday, March 16 beginning at 10 a.m., where NASA Administrator Richard H. Truly will launch a new education project at the Spingarn Complex, 26th St. and Benning Rd.

The event will debut the first of what NASA hopes will become a small fleet of tractor-trailer mounted mobile teacher resource centers. Also participating will be D.C. School Superintendent Dr. Andrew Jenkins, NASA Deputy Administrator J. R. Thompson and Director of NASA's Marshall Space Flight Center Jack Lee.

After the ceremony, 14 D.C. teachers will experience hands-on activities in the 22-ton mobile education center. A NASA educator and 2 technicians will be on-hand to assist teachers.

The mobile teacher resource center is part of a larger NASA education initiative, project LASER, "Learning About Science, Engineering and Research." Friday afternoon, about 100 D.C. teachers will tour LASER.

LASER is outfitted with six work stations, each serving two teachers concurrently. Each work station is equipped with a computer providing access to "NASA Spacelink," an electronic information system with a broad range of information and educational materials of value to teachers of grades K-12. The work station also includes a videotape recorder and monitoring system so teachers can copy from a large library of NASA educational videotapes. In a separate common-use work station is a large library of lesson plans, activities and slides. The trailer contains photocopy and photographic equipment that will allow teahers to copy these materials for later use in the classroom.

This pilot program has been developed by NASA's Marshall Space Flight Center, Huntsville, Ala., with corporate sponsorship.

- end -

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For Release:
March 15, 1990

RELEASE: C90-i

BALL CORP. SELECTED FOR EARTH OBSERVATION INSTRUMENT STUDY

NASA Langley Research Center, Hampton, Va., has selected Ball Corp. of Boulder, Colo., for a contract to develop an atmospheric instrument for NASA's proposed Earth Observing System (EOS). EOS, a requested new start for Fiscal Year 1991, is a major space initiative to advance scientific understanding of the Earth. EOS will provide global, simultaneous interdisciplinary data on the Earth's land masses, oceans, atmosphere and biosphere.

The two-phase contract for the Spectroscopy of the Atmosphere Using Far Infrared Emission (SAFIRE) is valued at $90,124,000. SAFIRE consists of five optical modules and a control electronics module mounted on a common optical bench. SAFIRE will study middle-atmosphere ozone distribution through global-scale measurements of the important chemical, as well as the radiative and dynamical processes that influence ozone changes.

Phase one, a $695,700 cost-reimbursement contract, is for 21 months to conduct a design study. The first portion of phase two, valued at $70,635,000, will be for 90 months to complete the final design and fabricate the proto-flight model and flight model one. The second part of phase two, valued at $18,793,000, covers flight model two. The contract will be effective March 15, 1990, and the work will be performed by the Ball Electro-Optics/Cryogenics Division in Boulder. All but the first phase of the contract are conditional on Congressional approval of the EOS program.

- more -

Ball Corp. will design and build the three instruments, including a mass model, spares and brassboard hardware; develop and validate all flight and ground support hardware; and support spacecraft integration and launch planning. In addition, the contractor will coordinate with the international partners in SAFIRE, the United Kingdom, Italy and France, on their hardware contributions to the instrument.

- end -

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For Release:
March 15, 1990

RELEASE: 90-38

HUBBLE POSTDOCTORAL FELLOWSHIP PROGRAM ESTABLISHED

NASA and the Space Telescope Science Institute (STScI), Baltimore, Md., in cooperation with astronomical institutions throughout the United States, have taken a major step toward creating the astronomy leaders of tomorrow with the inauguration of the Hubble Postdoctoral Fellowship Program.

The largest such program of its kind, the Hubble Fellowship Program will help ensure that some of the best young scientific talent in astronomy and physics will be awarded an opportunity to conduct important research on challenging discoveries using NASA's Hubble Space Telescope (HST).

The launch of the HST on April 12, 1990, will usher in a new "golden age" for astronomy. HST is the flagship of NASA's Great Observatories Program, where major scientific spacecraft will be lofted above Earth's atmosphere to yield an unprecedented view of the universe across a broad swath of the electromagnetic spectrum. The vast amount of information returned by NASA's Great Observatories will have an enormous impact on modern day astronomy. There will be a tremendous requirement for skilled astronomers to conduct research and analysis on the data generated by NASA's space astrophysics programs of the 1990's and beyond.

The Hubble Fellowship Program will fund research opportunities for a significant portion of the pool of approximately 200 Ph.D. astronomers that graduate annually. Up to 15 new Hubble Fellowships will be added per year, for 3-year terms. Eventually the program will support a pool of up to 45 astronomers annually.

- more -

The highly qualified post-doctoral scientists selected for this program will have an opportunity to conduct HST-related research of their choice at participating astronomical institutions throughout the U.S. To avoid an excessive concentration of talent at any one astronomy institution, no more than two fellows per year are approved for any single institution.

The Hubble Fellows will collaborate with university-based scientists on HST data analysis. As archival data becomes available from HST in subsequent years, future Hubble Fellows will have an opportunity to analyze this data as well. Candidates are selected annually on the basis of merit (publications, research proposal, academic achievements) after which the STScI Director makes the final selection.

FIRST HUBBLE POSTDOCTORAL FELLOWSHIP PROGRAM RECIPIENTS

Pawel Artymowicz, University of California at Santa Cruz
Stefi A. Baum, The Johns Hopkins University, Baltimore, Md.
Michael J. Bolte, University of California at Santa Cruz
Laura Danly, Space Telescope Science Institute
Andrew S. Fruchter, University of California at Berkeley
Neal S. Katz, Princeton University Observatory, Princeton, N.J.
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Mario L. Matteo, The Carnegie Institute of Washington
Charles C. Steidel, California Institute of Technology, Pasadena
Manfred Vogel, Space Telescope Science Institute
Rene A.M. Walterbos, The John Hopkins University
Quinde Wang, Columbia University, New York, N.Y.
Janet H. Wood, University of Texas at Austin
Brian P. Yanny, Institute for Advanced Study, Princeton, N.J.

- end -

Beginning March 15, 1990, NASA news releases and other NASA information will be available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. On the same date, NASA information on the Dialcom electronic service will be discontinued. For information on CompuServe, call 1-800-848-8199 and ask for representative 176. For information on GEnie, call 1-800-638-9636.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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For Release:
March 13, 1990

RELEASE: 90-39

INTERNATIONAL CONFERENCE ADDRESSES GLOBAL BURNING

A NASA senior research scientist, Dr. Joel S. Levine of the Langley Research Center, Hampton, Va., will lead the first international scientific discussion on global biomass burning as convenor of the Chapman Conference on Global Biomass Burning on March 19-23, 1990, in Williamsburg, Va.

The international conference, at the Williamsburg Hilton Convention Center, will bring together leading scientists and environmental policy planners from more than 25 countries, including Brazil, the Soviet Union, China, India, Western European and several African nations. Attendees will attempt to estimate how much of the Earth's surface burns each year and the amount of harmful gases produced. Participants also will consider the impact these gases have on the chemistry of the atmosphere, on climate and on the biosphere.

On an average day, thousands of acres of land are set afire. Such large-scale burning of the Earth's biological material damages ecosystems well beyond the immediate consequences of the fire. "When the smoke dissipates, the climatically dangerous greenhouse gases, produced by burning of forests, grasslands and vegetation, are just beginning their negative impact on our atmosphere," said Levine.

One of the most pressing questions the conference will address is how biomass burning, ranging from the clearing of the Amazon rain forest to the worldwide burning of agricultural stubble, contributes to global change. "Over the past few years, biomass burning has been identified as a major source of three of the most important greenhouse gases in the atmosphere: carbon

- more -

dioxide, methane and nitrous oxide," Levine said. "This combined burning may produce 25-40 percent as much carbon dioxide as fossil-fuel burning, the predominant source of carbon dixoide emissions.

"We believe that more than 95 percent of global burning is human initiated and can be stopped once the world's leaders are aware of its detrimental environmental consequences," Levine said. "This is one area of science where we can affect a reversal of a dangerous trend by raising awareness and public education. This is one of the goals of the Williamsburg conference."

On Friday, March 23, from 2 to 3:30 p.m., a panel discussion will be broadcast live over the PBS TV network and the Westar IV satellite. Levine will moderate three panels of scientists who will address the scientific aspects of global burning; its political, economic and social implications; and public education and awareness of environmental issues. A toll-free telephone number will enable viewers to question the panelists. The program is being planned by the Langley Research Center, the PBS network, local PBS affiliate WHRO-TV and the Virginia Department of Education.

The international conference is sponsored by the American Geophysical Union, Washington, D.C.; NASA Headquarters, Washington, D.C. and the Langley Research Center. Supporting the meeting are the National Science Foundation, the U.S. Environmental Protection Agency, the U.S. Forest Service, the International Geosphere/Biosphere Global Change Project and the International Global Atmosheric Chemistry Project.

- end -

Note to Editors: News media desiring more information, or wishing to participate in the Williamsburg Conference, may call Patrice Dickerson of the American Geophysical Union at 202/462-6900 or Marny Skora of Langley Research Center at 804/864-6126. Copies of most of the conference abstracts may be obtained by contacting Brian Dunbar, NASA Public Affairs, 202/453-1547.

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NASA News

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Jim Elliott
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For Release:
March 15, 1990

Released at the Goddard Space Flight Center, Greenbelt, Md.

NASA SEEKS SMALL LAUNCH VEHICLE PROPOSALS

NASA's Goddard Space Flight Center, Greenbelt, Md., has requested proposals from the commercial launch vehicle community for launch of up to ten small Explorer-class spacecraft between 1993 and 1998. The Request for Proposals (RFP) for Small Expendable Launch Vehicle (SELV) services was issued on February 27, 1990. It calls for procurement of launch services for seven firm missions with options for ordering services for three additional missions during the five year time period. Specific spacecraft will be assigned to the seven firm missions at a later date.

The RFP calls for the prospective contractor to furnish all supplies, including the launch vehicle, facilities, personnel and services necessary to design, produce, test, integrate and launch the missions into the required orbit.

The Orbital Launch Services Project at Goddard will oversee the contractor activities provided under this contract. Proposals from commercial interests are to be submitted by April 30, 1990. Contract award is expected to take place in early 1991.

- end -

EDITORS NOTE: Copies of the SELV RFP are available for viewing in the newsrooms at Goddard and NASA Headquarters.

NASA News

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For Release:
March 16, 1990
IMMEDIATE

N90-16

NOTE TO EDITORS: STS-31 BRIEFING DATE CHANGE

Due to a change of date in the terminal countdown demonstration test (TCDT), the STS-31 briefings and crew press conference, originally scheduled for March 19 at the Johnson Space Center, Houston, have been postponed until Thursday, March 22.

T-0 for the TCDT, orginally set for Thursday, was moved to Tuesday because of a revision in launch pad activities at the Kennedy Space Center. TCDT is the crew's traditional dress rehearsal for launch day.

The briefings will begin at 9:30 a.m. EST, Thursday, with Flight Director Bill Reeves. A briefing regarding the secondary payloads and the student experiment is set for 10:30 a.m., followed by the crew press conference and round robin interviews beginning at 11:30 a.m.

All briefings will be carried on NASA Select television with two-way Q and A capability.

-end-

NASA News

National Aeronautics and
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For Release:
Embargoed Until
March 16, 1990

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RELEASE: 90-41

STUDY DETECTS POSSIBLE OZONE LOSS OVER ARCTIC

Chemical processes that lead to ozone depletion in the Antarctic are present in the far Northern Hemisphere, and some regions of the Arctic stratosphere may have suffered ozone losses up to 17 percent during the winter of 1988-89, results of the 1989 Airborne Arctic Stratospheric Expedition (AASE) indicate.

At the conclusion of the mission in February, AASE scientists released a statement that "no unequivocal signature of photochemical loss of Arctic ozone was identified before the end of this mission. However, by the end of this mission a considerable portion of the vortex air was primed for destruction."

After almost a year of analysis has refined that conclusion, with several investigators, using different analytical methods, reported the Arctic ozone losses. For example, a team led by Dr. Edward Browell of NASA's Langley Research Center, Hampton, Va., used a laser-based technique similar to radar to measure ozone distribution and observed depletions of up to 17 percent at some altitudes.

A group led by Dr. Mark Schoeberl of Goddard Space Flight Center, Greenbelt, Md., inferred average photochemical ozone losses of 0.44 percent per day over the mission at altitudes above approximately 12 miles.

- more -

Chemical analyses showed increased levels of active chlorine and lower-than-expected levels of nitrogen oxides in the atmosphere. In their prologue, Richard Turco of UCLA, Alan Plumb of MIT and Estelle Condon of NASA's Ames Research Center, Mountain View, Calif., wrote that these measurements indicate that chemically "the Arctic stratosphere is primed for an ozone hole." Meteorological conditions, however, were found to be unsuitable for the development of an Arctic ozone hole similar to the one observed over the Antarctic.

An "ozone hole" similar to the one that appears annually over the South Pole is unlikely to occur in the north because of substantially different weather patterns there. In the Antarctic, the photochemical breakdown of ozone is aided by a strong vortex of stratospheric winds that circle a continent-sized area and effectively isolate air over the pole. Within the vortex, cold temperatures enhance the formation of polar stratospheric clouds (PSCs), which serve as catalysts in the transformation of non-reactive chlorine compounds into reactive chlorine. Whereas the Antarctic vortex often remains intact for most of the austral spring, the Arctic vortex usually breaks up before the spring sunrise can begin the chlorine-ozone reactions.

More than a third of the AASE papers focus on PSCs, key components of the chemistry of ozone depletion. In situ and satellite measurements defined the microscopic structures of PSCs, with the results indicating that nitric acid vapor is a key element in PSCs' formation and therefore, that denitrification of the stratosphere is an indicator that the potential for ozone depletion exists. Turco, Plumb and Condon, however, cautioned that the exact process of PSC formation is not fully understood.

The papers resulting from the AASE address a wide range of ozone-related issues, from meteorology and polar stratospheric clouds to trace chemistry and ozone depletion. The January 1989 expedition, based in Stavanger, Norway, flew a variety of instruments to measure meteorological conditions and atmospheric physics and chemistry on 28 flights of NASA's ER-2 and DC-8 research aircraft.

The findings of the expedition, coordinated by NASA and co-sponsored by the National Oceanic and Atmospheric Administration, the National Science Foundation and the Chemical Manufacturers Association, will be published in the April issue of Geophysical Research Letters, a publication of the American Geophysical Union.

Scientists from the National Center for Atmospheric Research, Harvard University, University of Denver, NASA and NOAA took part, with international participation from Norway, United Kingdom, the Federal Republic of Germany, Denmark and Sweden.

- end -

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For Release:
March 16, 1990

RELEASE: 90-42

GODDARD TROPHY CEREMONY PLANNED AT WHITE HOUSE

Vice President Dan Quayle, in a special White House ceremony on March 19, will make a special presentation of the Dr. Robert H. Goddard Memorial Trophy to the 1990 winner Dr. Lew Allen, Director of the NASA Jet Propulsion Laboratory, Pasadena, Calif., and Vice President of the California Institute of Technology.

Dr. Allen received the 1990 award "For distinguished and significant contributions to the Nation's advancement in space, earlier by service with the Air Force and the strategic defense of the country, and currently by leadership with NASA in the assurance of United States preeminence in planetary exploration."

The Goddard Trophy, premier award of the National Space Club and the aerospace industry, was established in 1958 and is presented each year at the Goddard Memorial Dinner. The recipient of this award is selected annually by the Board of Governors of the National Space Club.

- end -

NASA News

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For Release:
March 22, 1990

INFORMAL MONTHLY REVIEW SCHEDULED

The informal monthly review by officials of the NASA Office Of Space Flight will be held Friday, March 23, from 4 to 6 p.m. in Room 425, NASA Headquarters, 600 Independence Ave., S.W., Washington, D.C.

Associate Administrator for Space Flight Dr. William Lenoir, Director Of Space Station Freedom Program Richard Kohrs and Director of Space Shuttle Program Captain Robert Crippen are planning to participate.

Space Shuttle, Space Station, EVA and maintenance issues will be discussed.

- end -

NASA News

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For Release:
March 23, 1990

RELEASE: 90-43

NASA F-15 DEMONSTRATES SELF-REPAIRING FLIGHT CONTROL SYSTEM

NASA research pilots have successfully tested a flight control system that detects in-flight failures and automatically reconfigures an aircraft's ailerons, rudders and elevators, allowing pilots to continue their missions or land safely.

The self-repairing flight control system, first system of its type in the aerospace industry, has been demonstrated on NASA's F-15 Highly Integrated Digital Electronic Control research aircraft based at Ames-Dryden Flight Research Facility, Edwards, Calif.

The primary purpose of the system is to detect damaged flight control components and adjust undamaged flight surfaces so the pilot can maintain good aircraft response. When the system senses a failure, it selects the best pre-computed solution from a set of control laws loaded into the F-15's computer. The system also can constantly monitor subsystems throughout the aircraft to diagnose and identify failures that are hard to repeat and isolate during post-flight maintenance.

"This is a very significant and far reaching development in aviation," said James F. Stewart, project manager of the F-15 research program at Ames-Dryden. "Once it is fully developed and operational, the self-repairing flight control concept could greatly increase tactical aircraft survivability in combat and enhance safety during training missions. It also has the potential for adaptation to civil aircraft, enhancing aircraft and passenger safety."

- more -

On the initial self-repairing system demonstration flight, NASA research pilot James Smolka, flying at Mach 0.7, purposely locked the F-15's right horizontal stabilator to represent a failure of hydraulic or electronic systems. The self-repairing system instantly reconfigured the remaining stabilator, ailerons and rudder to establish aircraft pitch and roll control with the right stabilator remaining in the "failed" state.

A battle damage scenario in which control effectiveness of the right stabilator was changed to simulate flight with 80 percent of the span missing was then demonstrated. The system correctly identified the "damage" and reset the other flying surfaces to restore normal controlled flight.

During self-repairing system activation, the pilot receives a preprogrammed visual warning on the cockpit heads up display that explains the type of system failure. This alert readout gives the pilot new flight limits such as reduced speed or maneuvering loads that the failure or battle damage may impose.

The maintenance diagnostic capability of the self-repairing system was demonstrated by five types of failures programmed into the F-15 research aircraft's flight computer. Each was selectable by the pilot and set to activate only under specified maneuver conditions. The system was able to identify all five intermittent electrical, mechanical and hydraulic faults. After the F-15 aircraft returned to Ames-Dryden, the failure data and appropriate repair instructions were displayed on a ground station screen that would have facilitated repair work to return the plane to 100 percent flight status.

An advanced self-repairing system is expected to be developed and thoroughly tested before the technology is used in future aircraft designs or retrofitted on existing aircraft. The operational envelope of such an advanced system may include landing tasks, supersonic speeds and flight in automatic terrain-avoidance and terrain-following modes.

Feasibility studies on the system began in 1984 at the Air Force's Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio. Ground-based and in-flight simulators verified the data before development of the system demonstrated on NASA's F-15 research aircraft.

Besides James Smolka, other NASA pilots taking part in the system development have been Tom McMurtry, chief of Ames-Dryden's Aircraft Operations Division and Ames-Dryden chief test pilot Bill Dana.

McDonnell Aircraft Co., St. Louis, and General Electric's Aircraft Control Division, Binghamton, N.Y., developed the self-repairing system under contract to NASA's Ames-Dryden facility. The U.S. Air Force Wright Research and Development Center, Wright-Patterson AFB, Ohio, sponsors the program.

- end -

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NASA News

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For Release:
March 27, 1990

N90-18

NOTE TO EDITORS:

B-52/PEGASUS LAUNCH SCHEDULED FOR APRIL 4

First mission of the Pegasus air-launched space booster is now scheduled for April 4. Pegasus will be launched from underneath the wing of a B-52 aircraft operated by NASA's Ames-Dryden Flight Research Facility, Edwards, Calif.

Pegasus is a three-stage space launch vehicle designed to deliver small payloads into low Earth orbit. Payloads for the first mission include PEGSAT, which carries instrumentation, a small satellite and barium chemical release experiments.

The Pegasus program is sponsored by the Department of Defense Advanced Research Projects Agency. Pegasus was developed by Orbital Sciences Corp., Fairfax, Va., and Hercules Aerospace Co., Wilmington, Del.

Launch will take place about 60 miles southwest of Monterey, over the Pacific Ocean. The event will be carried live on NASA Select television, Satcom F-2R, transponder 13.

There will be a post-mission press briefing, also carried on NASA Select, at the Ames-Dryden facility. Media will be able to photograph takeoff of the B-52/Pegasus. Takeoff time is planned for 11 a.m. PDT, with launch at about 12:10 p.m. PDT.

Media wishing to cover the mission should contact the Ames-Dryden Public Affairs Office, 805/258-8381, no later than April 2. Media who plan to photograph takeoff must be at the Dryden News Center no later than 9:45 a.m. PDT on launch day.

- end -

NASA

SPACE SHUTTLE MISSION STS-31
PRESS KIT

APRIL 1990

90-44

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National Aeronautics and
Space Administration

Washington, D.C.

RELEASE: 90-44

DISCOVERY TO STATION HUBBLE SPACE TELESCOPE IN EARTH ORBIT

Highlighting mission STS-31, the 35th flight of the Space Shuttle, will be deployment in Earth orbit of the Hubble Space Telescope (HST).

HST, the largest on-orbit observatory ever built, is capable of imaging objects up to 14 billion light years away. Unhampered by Earth's atmospheric distortion, resolution of HST images is expected to be 7 to 10 times greater than images from Earth-based telescopes.

Orbiting at an altitude of 330 nautical miles, the telescope will observe celestial sources such as quasars, galaxies and gaseous nebulae. HST also will monitor atmospheric and surface phenomena of the planets in Earth's solar system.

After launch, and once the payload bay doors are opened, the HST main power busses will be activated allowing initial communications to be established. This will begin a 90-day orbital verification period in which the telescope will be checked to ensure that all systems are operational and functioning. During this period, the crew cabin will be depressurized in preparation for contingency activities that may arise related to the telescope's deployment.

HST, which measures 43.5 feet long and 14 feet in diameter, is scheduled to be deployed on the second day of the 5-day flight. Umbilical disconnect is planned on orbit 16 followed by solar array extension and slew tests on orbits 17 and 18. The high gain antennae boom deployment also is scheduled for orbit 18. During HST checkout operations prior to release from the remote manipulator system (RMS) arm, Mission Specialists Bruce McCandless and Kathryn Sullivan will be prepared for an extravehicular activity (EVA) if necessary.

The RMS will maneuver the telescope to the release position on orbit 19 with release scheduled for 1:47 p.m. EDT on April 13 based on a nominal launch time. The IMAX Cargo Bay Camera will film various points of the checkout and release of HST. Once HST is released, Discovery's crew will maneuver the orbiter away from HST to a distance of about 40 nautical miles. For the next 45 hours, the crew will trail HST in the event a rendezvous and spacewalk are required in response to a failure during the opening of the telescope's aperture door which protects the 94 1/2 inch mirror -- the smoothest ever made. Activation of HST's six onboard scientific instruments will follow aperture door opening on flight day three, orbit 39. The remainder of the flight is reserved for middeck experiment operations.

Joining HST in the payload bay will be the Ascent Particle Monitor to measure particle contamination or particle detachment during the immediate prelaunch period and during Shuttle ascent. Also in the payload bay is an IMAX camera containing about 6 minutes of film. Discovery's middeck will carry a variety of experiments to study protein crystal growth, polymer membrane processing, and the effects of weightlessness and magnetic fields on an ion arc.

Commander of the mission is Loren J. Shriver, Air Force Colonel. Charles F. Bolden Jr., Marine Corps Colonel, will serve as pilot. Shriver was pilot of Discovery's third flight, STS-51C in January 1985, the first dedicated Department of Defense Shuttle mission. Bolden previously was pilot of Columbia's seventh flight in January 1986.

Mission specialists are Steven A. Hawley, Bruce McCandless II and Dr. Kathryn D. Sullivan. Hawley will operate and release HST from the RMS arm. Hawley's previous spaceflight experience includes Discovery's maiden voyage, STS-41D and Columbia's seventh flight, STS-61C. McCandless previously flew on STS-41B, Challenger's fourth flight. Sullivan flew on Challenger's sixth mission, STS-41G.

Liftoff of the tenth flight of Discovery is scheduled for 9:21 a.m. EDT on April 12 from Kennedy Space Center, Fla., launch pad 39-B, into a 330 by 310 nautical mile, 28.5 degree orbit. Nominal mission duration is expected to be 5 days 1 hour 15 minutes. Deorbit is planned on orbit 75, with landing scheduled for 10:36 a.m. EDT on April 17 at Edwards Air Force Base, Calif.

- END OF GENERAL RELEASE -

GENERAL INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, C-band located at 72 degrees west longitude, frequency 3960.0 MHz, vertical polarization, audio monaural 6.8 MHz.

The schedule for tv transmissions from the orbiter and for the change-of-shift briefings from Johnson Space Center, Houston, will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Johnson Space Center; Goddard Space Flight Center, Greenbelt, Md. and NASA Headquarters, Washington, D.C. The schedule will be updated daily to reflect changes dictated by mission operations.

TV schedules also may be obtained by calling COMSTOR, 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. Voice updates of the TV schedule may be obtained by dialing 202/755-1788. This service is updated daily at noon EDT.

Special Note to Broadcasters

In the 5 workdays before launch, short sound bites of astronaut interviews with the STS-31 crew will be available to broadcasters by calling 202/755-1788 between 8 a.m. and noon EDT.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA news center.

Briefings

An STS-31 mission press briefing schedule will be issued prior to launch. During the mission, flight control personnel will be on 8-hour shifts. Change-of-shift briefings by the off-going flight director will occur at approximately 8-hour intervals.

STS-31 QUICK LOOK

Launch Date:	April 12, 1990
Launch Window:	9:21 a.m. - 1:21 p.m. EDT
Launch Site:	Kennedy Space Center, Fla.
Launch Complex:	39B
Orbiter:	Discovery (OV-103)
Altitude:	330 circular
Inclination:	28.45
Duration:	5 days, 1 hour, 15 minutes
Landing Date/Time:	April 17, 1990, 10:36 a.m. EDT
Primary Landing Site:	Edwards Air Force Base, Calif.
Abort Landing Sites:	Return to Launch Site -- KSC TransAtlantic Abort - Ben Guerir, Morocco Abort Once Around - Edwards AFB, Calif.
Crew:	Loren J. Shriver - Commander Charles F. Bolden Jr - Pilot Steven A. Hawley - MS-2 Bruce McCandless II - MS-1 and EV1 Kathryn D. Sullivan - MS-3 and EV2
Cargo Bay Payloads:	Hubble Space Telescope IMAX Cargo Bay Camera
Middeck Payloads:	Ascent Particle Monitor (APM) Investigations into Polymer Membrane Processing (IPMP) Ion Arc (Student Experiment) Protein Crystal Growth (PCG-III)

SUMMARY OF MAJOR ACTIVITIES

Day One

Ascent	RMS checkout
Post-insertion	DSO
Unstow cabin	EMU checkout
10.2 cabin depress	PCG activation

Day Two

HST deploy	IMAX
DSO	IPMP activation

Day Three

DSO/DTO	Ion Arc (Student Exp)
IMAX	RME Memory Module Replacement

Day Four

14.7 repress	IMAX
DSO	RME Memory Module Replacement

Day Five

AMOS	PCG deactivation
DSO	RCS hotfire
FCS checkout	RME deactivation
IMAX	Cabin stow

Day Six

DSO	Deorbit burn
Deorbit preparations	Landing at EAFB

TRAJECTORY SEQUENCE OF EVENTS

EVENT	MET (d:h:m:s)	RELATIVE VELOCITY (fps)	MACH	ALTITUDE (ft)
Launch	00/00:00:00			
Begin Roll Maneuver	00/00:00:09	160	.14	605
End Roll Maneuver	00/00:00:15	313	.28	2,173
SSME Throttle Down to 67%	00/00:00:28	656	.58	7,771
Max. Dyn. Pressure (Max Q)	00/00:00:51	1,155	1.07	25,972
SSME Throttle Up to 104%	00/00:00:59	1,321	1.26	33,823
SRB Staging	00/00:02:06	4,145	3.77	159,670
Negative Return	00/00:04:06	7,153	7.15	341,470
Main Engine Cutoff (MECO)	00/00:08:33	24,768	23.18	361,988
Zero Thrust	00/00:08:39	24,783	22.65	366,065
ET Separation	00/00:08:51			
OMS 2 Burn	00/00:42:38			
HST Deploy (orbit 19)	01/05:23:00			
Deorbit Burn (orbit 75)	05/00:03:00			
Landing (orbit 76)	05/01:15:00			

Apogee, Perigee at MECO: 325 x 27
Apogee, Perigee post-OMS 2: 330 x 310
Apogee, Perigee post deploy: 332 x 331

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

• Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

• Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.; White Sands Space Harbor (Northrup Strip), N.M.; or the Shuttle Landing Facility (SLF) at Kennedy Space Center (KSC), Fla.

• Trans-Atlantic Abort Landing (TAL) -- Loss of two main engines midway through powered flight would force a landing at Ben Guerir, Morocco; Moron, Spain; or Banjul, The Gambia.

* Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines and without enough energy to reach Ben Guerir, would result in a pitch around and thrust back toward KSC until within gliding distance of the SLF.

STS-31 contingency landing sites are Edwards AFB, White Sands, KSC, Ben Guerir, Moron and Banjul. For a contingency return of Discovery with the Hubble Space Telescope, conditioned purge air will be supplied to the payload bay within 40 minutes after landing.

STS-31 PRELAUNCH PROCESSING

Shuttle processing activities at Kennedy Space Center for the STS-31/Hubble Space Telescope mission began on Dec. 3, following the orbiter Discovery's return to KSC after completion of the STS-33 mission of November 1989.

During its 3-month stay in the Orbiter Processing Facility, Discovery underwent some 36 modifications to its structural, flight and onboard systems. These modifications included the installation of new carbon brakes which will provide greater stopping power and control during landing. The brakes have undergone extensive preflight testing at Wright Patterson AFB in Ohio, with further testing to be conducted under actual landings conditions. The high pressure oxidizer turbo pumps on Discovery's main engines have been instrumented for the first time to provide data on bearing wear. The data provided, along with a post-flight analysis of the pumps, will help determine whether the pumps need to be rebuilt after each flight as is currently the case. The location of Discovery's main engines are the same as for the last mission: 2011 in the No. 1 position, 2031 in the No. 2 position and 2107 in the No. 3 position.

The remote manipulator system was installed in Discovery's payload bay and checked out during the first two weeks in January. The robot arm will be used to deploy the Hubble Space Telescope.

Discovery's right aft solid rocket booster was replaced with one designated for the STS-35 mission after data indicated that a critical leak test had not been performed correctly on one of the internal joints. The replacement was necessary because the location of the joint precluded retesting at KSC. The assembled vehicle, atop mobile launcher platform 2, was rolled out to Launch Pad 39B on March 15.

The Hubble Space Telescope arrived at KSC from the Lockheed Sunnyvale, Calif. facility on Oct. 4, 1989, and began prelaunch testing in the Vertical Processing Facility. It was powered up on Oct. 28 via satellite command from Lockheed's HST control facility in Sunnyvale, beginning 40 days of functional testing of its operating systems and science instruments. These tests included 11 days of on-orbit simulations via satellite link with the Space Telescope Operations Control Center (STOCC) at Goddard Space Flight Center, Greenbelt, Md.

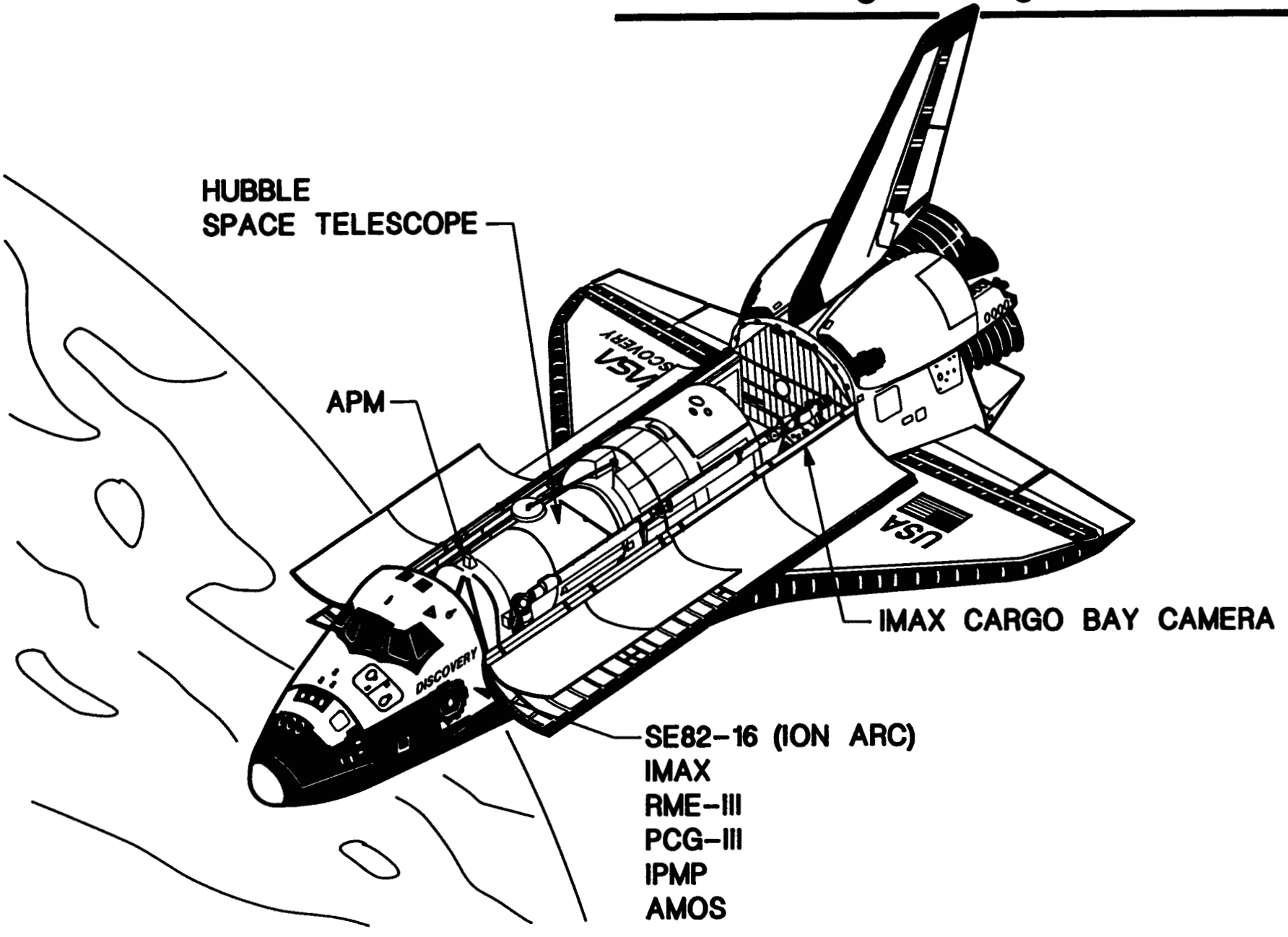
The launch countdown is scheduled to begin 3 days prior to launch. During the countdown, the orbiter's onboard fuel storage tanks will be loaded and all orbiter systems will be configured for flight. About 9 hours before launch, the external tank will be loaded with its flight load of liquid oxygen and liquid hydrogen propellants.

Discovery is scheduled to land at Edwards AFB, Calif. KSC's landing and recovery team at NASA's Ames-Dryden Flight Research Facility will prepare the vehicle for its ferry flight back to KSC, expected to begin approximately 5 days after landing.

PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Weight (pds)
Orbiter Discovery Empty	151,314
Remote Manipulator System (payload bay)	858
Hubble Space Telescope (payload bay)	23,981
Ascent Particle Monitor (payload bay)	47
IMAX system (payload bay)	374
DSO	77
DTO	289
HST middeck equipment	127
IMAX (middeck)	271
Investigation into Polymer Membrane Processing (IPMP)	17
Ion Arc (Student Experiment)	54
Protein Crystal Growth (PCG)	85
Radiation Monitoring Experiment (RME)	7
Orbiter and Cargo at main engine cutoff	259,229
Total Vehicle at SRB Ignition	4,516,325
Orbiter Landing Weight	189,477

STS-31 Cargo Configuration



HUBBLE SPACE TELESCOPE

The Hubble Space Telescope and its Elements

The HST weighs approximately 24,000 pounds, is 43 feet long, and 14 feet in diameter at its widest point. Roughly the size of a railroad tank car, it looks more like two huge cylinders joined together and wrapped in aluminum foil. Wing-like solar arrays extend horizontally from each side of these cylinders, and dish-shaped antennas stretch out on rods above and below the body of the telescope.

Many of the telescope's components are of modular design so they may be removed and replaced in orbit by astronauts. Though other spacecraft have received emergency repairs from Shuttle crews, the HST is the first specifically designed for on-orbit servicing.

The HST is made up of three major elements: the support systems module, the optical telescope assembly, and the scientific instruments.

The support systems module consists of the exterior structure of the HST and the various systems that make it possible for the optical telescope assembly and the scientific instruments to do their job.

The foil-like material with which the telescope is wrapped is actually multi-layer insulation, part of the telescope's thermal control system. The metallic silver surface reflects much of the direct sunlight which strikes the telescope to keep it from overheating. Tiny heaters are attached to many telescope components to warm them during the "eclipse" phase of orbit, when in the Earth's shadow.

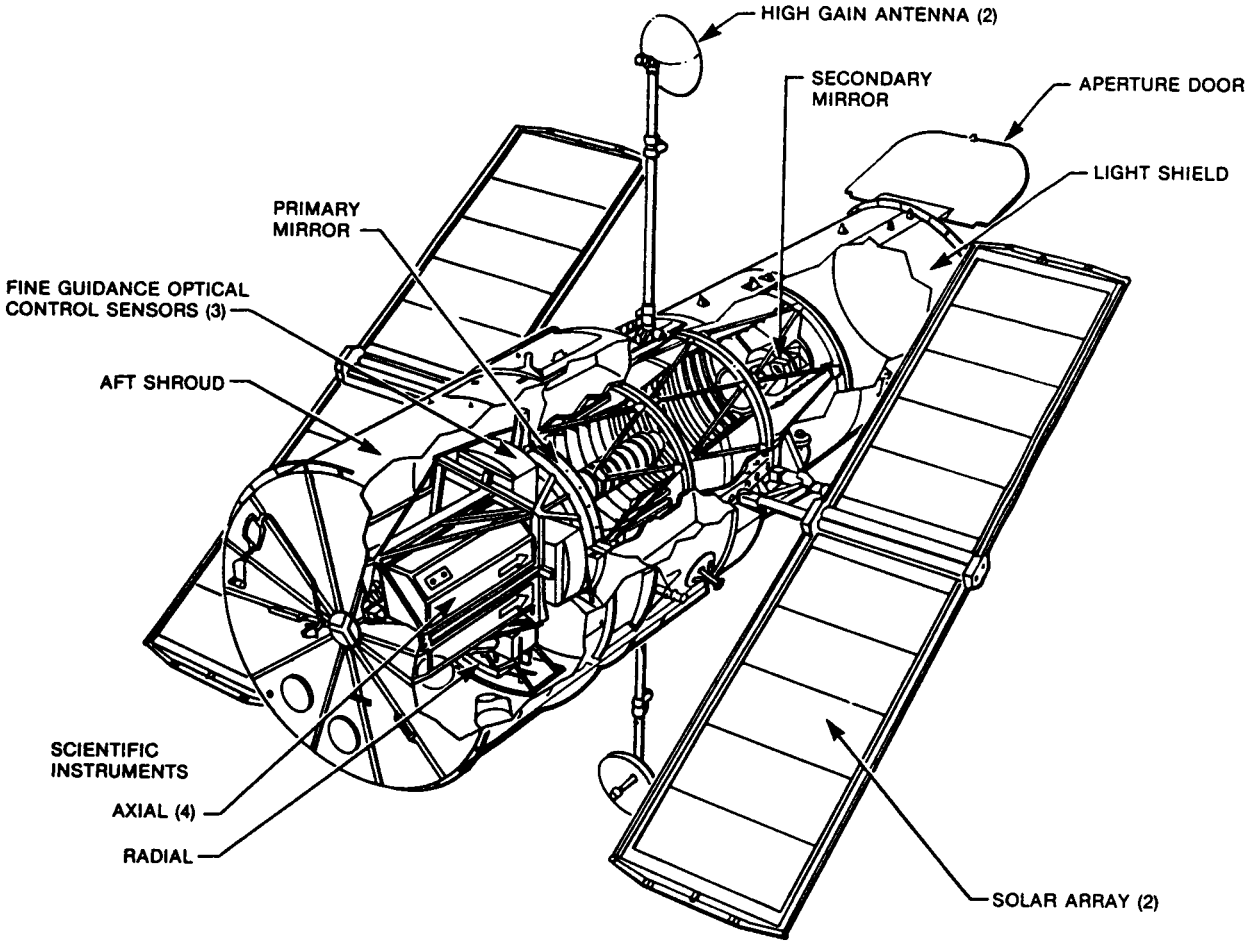
Electrical power for the HST is collected from the sun by the European Space Agency's solar arrays. These two "wings" contain 48,000 solar cells. They convert the sun's energy to electricity during the portion of orbit that it is exposed to sunlight. The power is stored in six Nickel Hydrogen batteries to support the telescope during eclipse.

When conducting an observation, the space telescope is rotated into the proper orientation, then pointed to the star it is to view and locked in place, by the pointing control system. This system is made up of a complex series of gyroscopes, star trackers, reaction wheels and electromagnets. The gyroscopes and reaction wheels are used to produce a coarse pointing toward the star. That pointing is fine-tuned by star trackers called fine guidance sensors. These sensors can locate and lock on to a position in the sky to within 0.01 arc second and can hold that pointing without varying more than 0.007 arc second for as long as 24 hours.

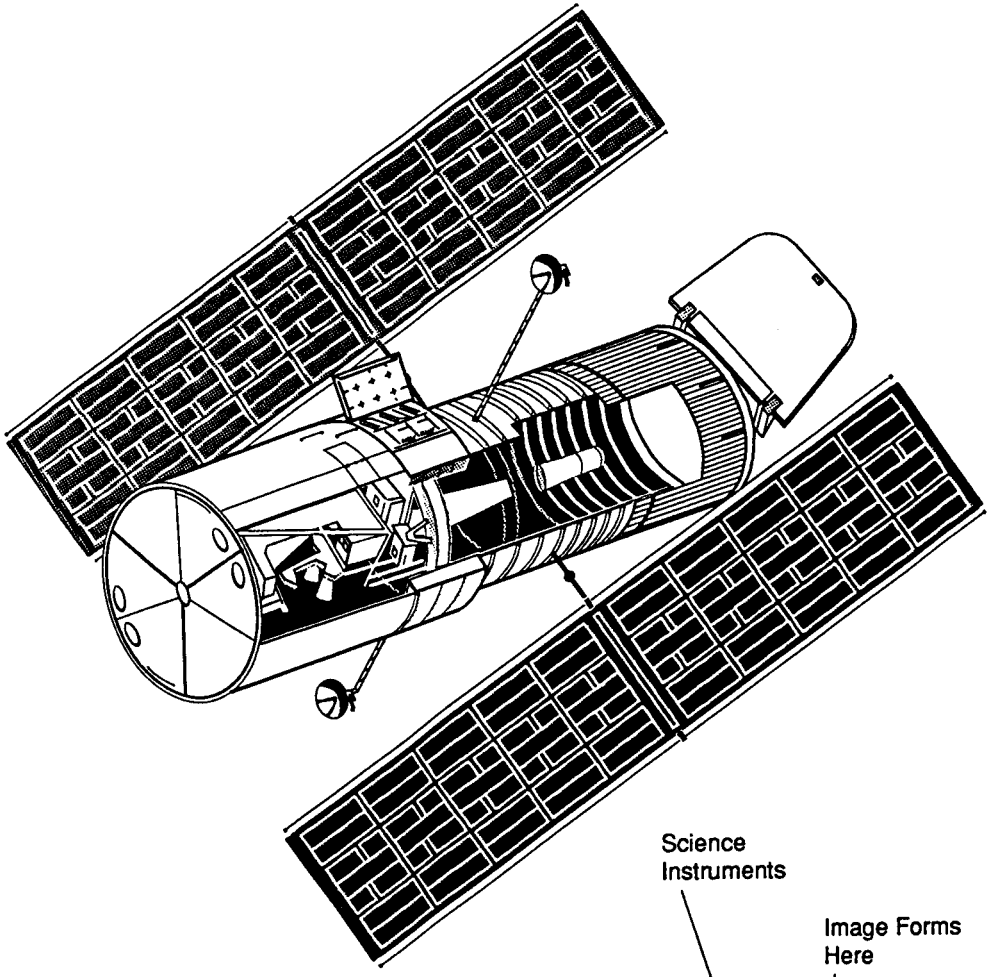
Also included in the support systems module are the computer which controls the overall spacecraft; high-gain antennas which receive ground commands and transmit data back to Earth; the electrical power system; the structure of the telescope itself and its mechanical parts; and the safing system, designed to take over control of the telescope to protect it from damage in case of serious computer problems or loss of communication with ground controllers.

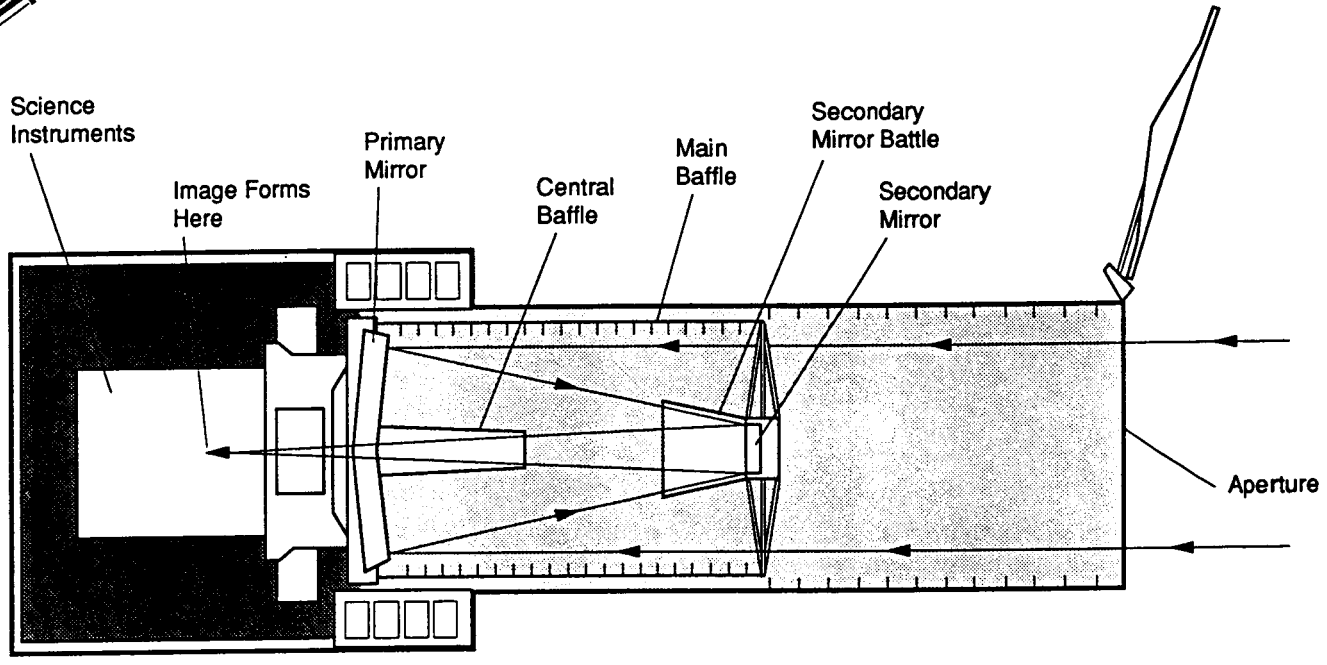
The optical telescope assembly contains the two mirrors which collect and focus light from the celestial objects being studied. The 94-inch primary mirror is located near the center of the HST. Made of precision-ground glass with an aluminum reflecting surface, it is the smoothest large mirror ever made. To reduce weight, the front and back plates are fused to a honeycomb core. The 13-inch secondary mirror is located 16 feet in front of the primary mirror. It is set far enough inside the open end of the telescope to assure that stray light does not interfere with the image being studied. In addition, three black cylinders called baffles surround the path of light to block out unwanted rays.

OVERALL HUBBLE SPACE TELESCOPE CONFIGURATION



CUTAWAY VIEWS OF HUBBLE SPACE TELESCOPE





The two mirrors must remain in precise alignment for the images they collect to be in focus. But the space environment is a hostile one. The space telescope will experience wide variations in temperature as it passes from the sun to shade portions of its orbit. Expansion and contraction from the temperature extremes could easily cause the mirrors to go out of focus. Therefore, the mirrors are made of a special kind of glass formulated to resist that expansion and contraction. The telescope's insulation blankets and solar-powered heaters will maintain them at 70 degrees Fahrenheit. In addition, the mirrors are held a precise distance from one another by an extremely strong but lightweight truss structure. The truss is made from graphite epoxy, a material also chosen for its resistance to expansion and contraction in temperature extremes.

During observations, light from a celestial source travels through the tube of the telescope to the large primary mirror. It is then reflected from the primary mirror back to the secondary mirror. From there, the beam narrows and intensifies, then passes through a hole in the center of the primary mirror to a focal plane where the scientific instruments are located.

The Hubble Space Telescope's scientific instruments are the Wide Field/Planetary Camera, the Faint Object Camera, the Goddard High Resolution Spectrograph, the Faint Object Spectrograph, and the High Speed Photometer. The fine guidance system, in addition to being used for pointing, also performs scientific measurements and is sometimes called the sixth scientific instrument. Mounted on a focal plane almost five feet behind the primary mirror, these scientific instruments will furnish astronomers with a wide range of information about the stars and galaxies they study. Each instrument is contained in a separate module and operates on only 110 to 150 watts of power.

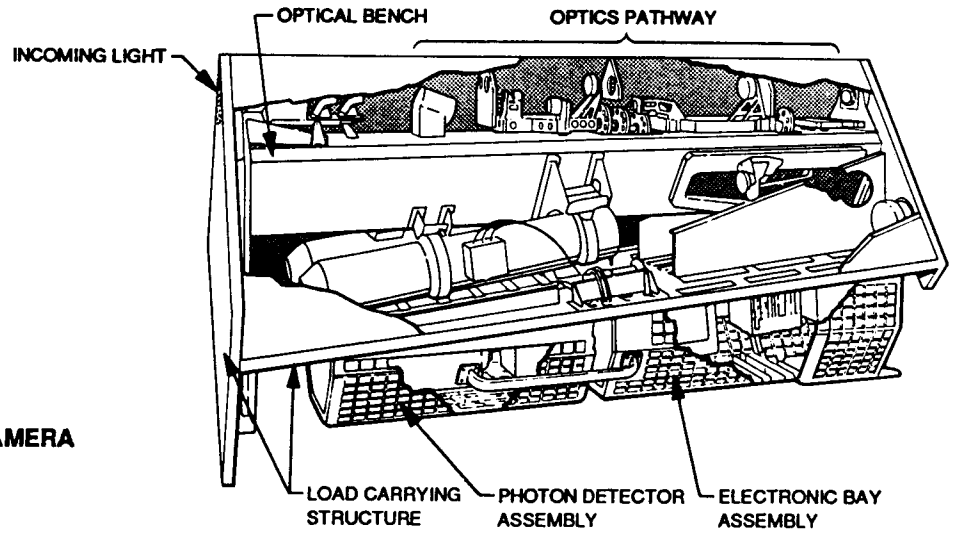
Science Instruments

The Wide Field/Planetary Camera (WF/PC) will be used to investigate the age of the universe and search for new planetary systems around young stars. It can compare near and far galaxies and observe comets such as Halley's comet, which we previously could only view every 75 years. As its name implies, the WF/PC can be used in two different ways. In its wide-field mode, its field of view will allow it to take pictures of dozens or even hundreds of distant galaxies at once. In the planetary mode, it will provide close-ups of all the planets in our solar system except Mercury, which is too close to the sun for safe pointing. The WF/PC can observe larger areas of the sky and more different forms of light (from far ultraviolet to near infrared) than any of the other science instruments. It will also produce a greater volume of information for analysis than any of the others.

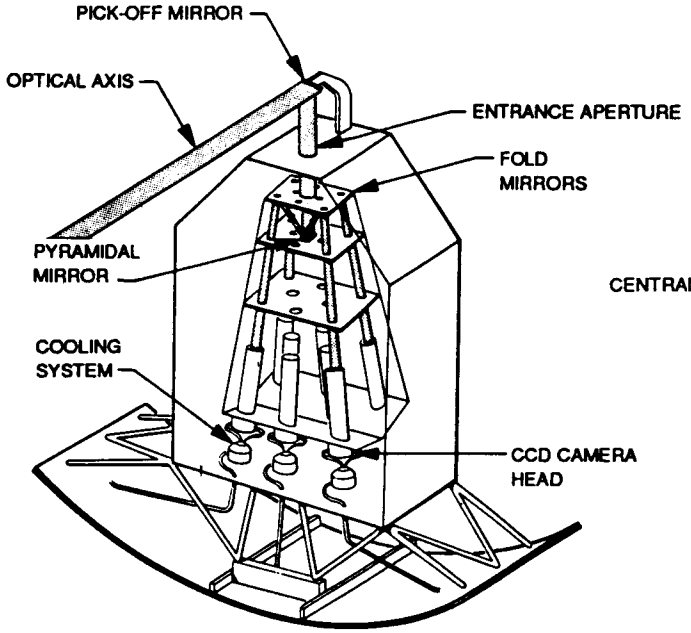
Though its field of view is greater than that of any other Hubble instrument, the "wide field" in this camera's name may be a little misleading. Typical wide-field cameras at ground observatories have a field of view of around 5 degrees. This camera's is only 2.67 arc minutes. It would take a montage of about 100 "wide-field" images to get a picture of the full moon. However, the narrower field of view allows much better resolution of far-away objects.

Although it will focus on an even smaller area than its wide-field counterpart, the Faint Object Camera (FOC) will extend the reach of the HST to its greatest possible distance and produce its sharpest images. It will be able to photograph stars five times farther away than is possible with telescopes located on the ground. Many stars and galaxies, now barely perceptible, will appear as blazing sources of light to the FOC. The camera will intensify images to a brightness 100,000 times greater than they were when received by the telescope. Then a television camera will scan the intensified images and store them in the camera's memory for transmission to the ground.

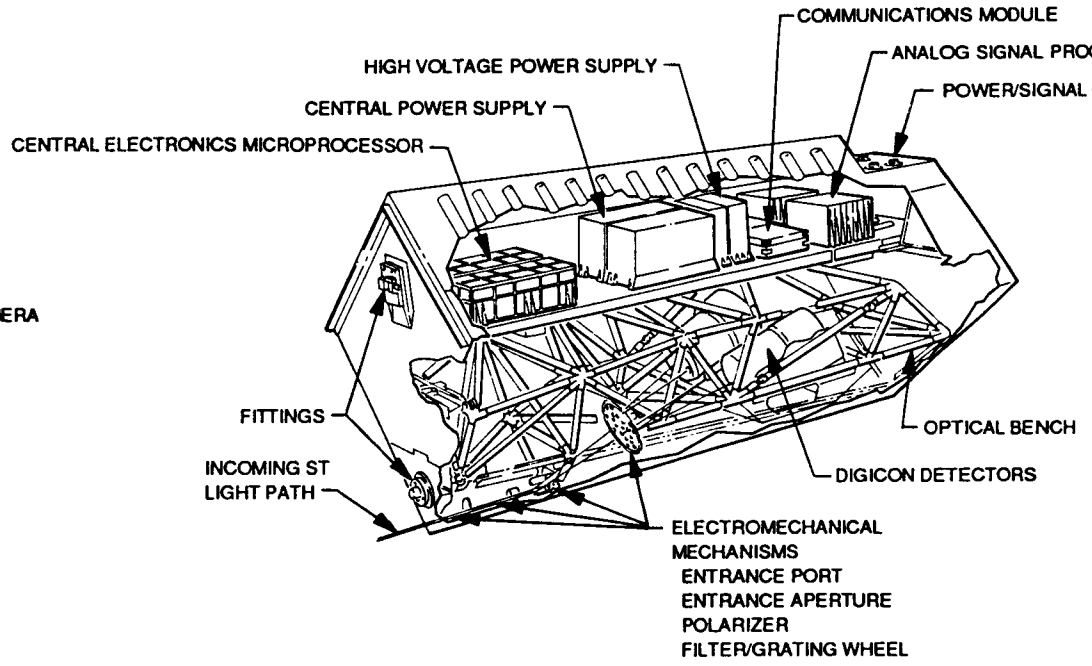
FAINT OBJECT CAMERA



WIDE FIELD/PLANETARY CAMERA



FAINT OBJECT SPECTROGRAPH



The FOC will be used to help determine the distance scale of the universe, peer into the centers of globular star clusters, photograph phenomena so faint they cannot be detected from the ground, and study binary stars (two stars so close together they appear to be one). It is part of the European Space Agency's contribution to the HST program.

Two spectrographs are also included in the HST's group of scientific instruments. A spectrograph does not take a photograph of the image it sees. Rather, one could say it takes its chemical "fingerprint." A spectrograph separates the radiation received from an object according to wavelengths, much as a prism splits visible light into colors. Every chemical element produces its own individual pattern on a spectrogram. So when the "fingerprint" of a certain element shows up on the spectrum, scientists know that element is present in the object being viewed. Scientists use spectrographs to determine the chemical composition, temperature, pressure and density of the objects they are viewing.

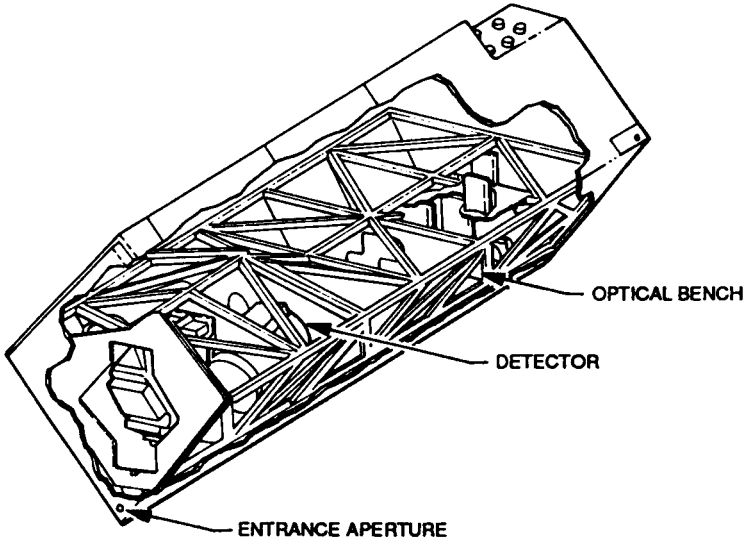
The Faint Object Spectrograph (FOS) will be used to analyze the properties of extremely faint objects in both visible and ultraviolet light. It will be able to isolate individual light sources from those surrounding them at very great distances. The FOS is equipped with devices that can block out light at the center of an image so the much fainter light around a bright object can be viewed. It will study the chemical properties of comets before they get close enough to the sun for their chemistry to be altered, as well as probing to see what the mysterious quasars are made of. This instrument will offer comparisons of galaxies that are relatively near Earth with those at great distances, helping researchers determine the history of galaxies and the rate at which the universe is expanding.

The Goddard High Resolution Spectrograph, though its work is similar to that of its faint object companion, has a specialized job. It is the only science instrument entirely devoted to studies of ultraviolet light. Its detectors are designed to be insensitive to visible light, since the ultraviolet emissions from stars are often hidden by the much brighter visible emissions. The "high resolution" in this instrument's name refers to high spectral resolution, or the ability to study the chemical fingerprints of objects in very great detail. The combination of this spectral resolution with the high spatial resolution of the cameras will allow scientists to determine the chemical nature, temperature, and density of the gas between stars. Its investigations will range from peering into the center of far-away quasars to analyzing the atmospheres of planets in our own solar system.

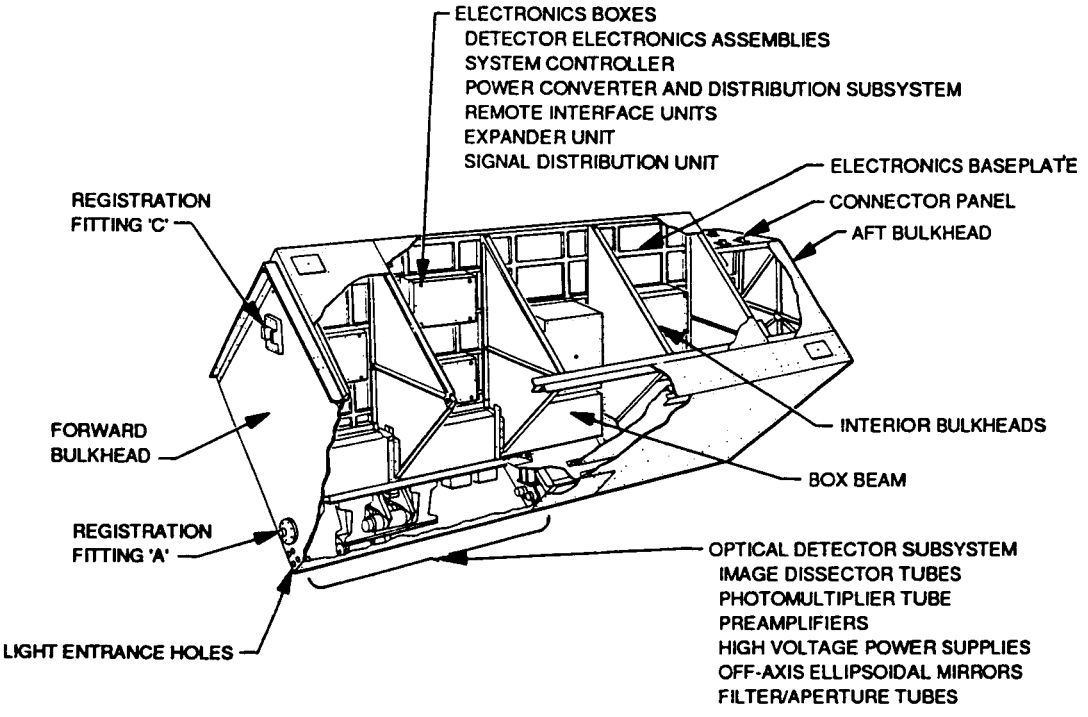
The High Speed Photometer, a relatively simple but precise light meter, will measure the brightness of objects being studied, as well as any variations in that brightness with time, in both the visible and ultraviolet ranges. The photometer will be able to study the smallest astronomical objects of any of the telescope's instruments. One of the photometer's tasks will be to look for clues that black holes exist in binary star systems. Variations in brightness would occur as one star revolves around the other. Irregularities in that variation might indicate that matter is being lost to a black hole--an object so dense that nothing, not even light, can escape from it. The photometer will also provide astronomers with an accurate map of the magnitude of stars.

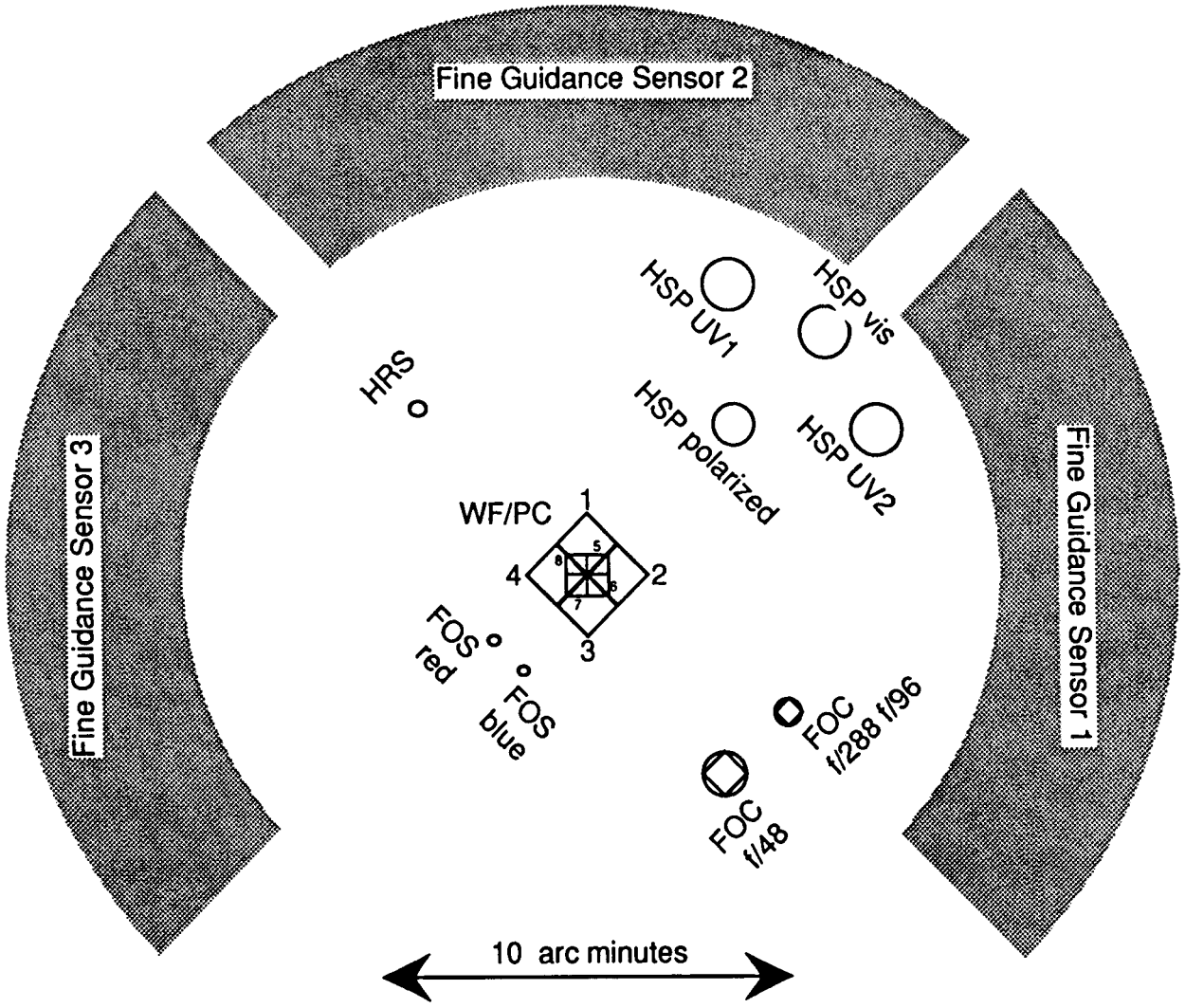
The three fine guidance sensors serve a dual purpose. Two of the sensors lock on to reference stars to point the telescope to a precise position in the sky, then hold it there with a remarkable degree of accuracy. The third sensor, in addition to serving as a backup unit, will be used for astrometry -- the science of measuring the angles between astronomical objects. These measurements will be combined with information from other instruments to prepare a more accurate distance scale of the universe.

GODDARD HIGH RESOLUTION SPECTROGRAPH



HIGH SPEED PHOTOMETER





Hubble Space Telescope
Field of View and Focal Plane Layout
(as seen from the instrument point of view)

ORBITAL VERIFICATION

HST's Orbital Verification (OV) program was established to verify that its subsystems are functioning properly after it has been placed in Earth orbit. As an extremely complex, precise and sensitive spacecraft, the HST will require an extensive period of activation, adjustment and checkout before it is turned over to the scientific community for their investigations.

This process is thorough and methodical. It has been carefully planned to assure that the telescope systems are not damaged during activation and that the telescope itself and its ground support systems are operating properly. Engineers and scientists will control this process from the Space Telescope Operations Control Center (STOCC), at Goddard Space Flight Center, Greenbelt, Md.

Orbital verification is divided into two phases. The first includes deployment of the Hubble Space Telescope, activation of its systems, and preliminary pointing and focusing. This phase is referred to as OV/1. A team from the Marshall Space Flight Center will be stationed at the Goddard Space Flight Center to manage this portion of verification. The Marshall manager in charge of this team, referred to as the Director of Orbital Verification (DOV), will give the final go-ahead for each step of the carefully-scripted process. Another Marshall team working in Huntsville will provide technical engineering support from the Huntsville Operations Support Center (HOSC). Actual commands will be sent to the telescope by Goddard mission operations personnel.

This first stage of orbital verification, OV/1, has four major goals: fine-tuning pointing accuracy, focusing the telescope, initially activating the scientific instruments and evaluating the performance of both the telescope and ground control systems.

The second phase, referred to as OV/2, will be managed by Goddard, with continued technical support furnished by Marshall. Activation and calibration of the various science instruments, modes, as well as continued refinements in alignment and focusing, will be accomplished during this period.

The OV program is scheduled to last for about 90 days from time of HST's deployment with the time divided roughly equally between the two Orbital Verification phases.

HST ACTIVATION IN DISCOVERY'S CARGO BAY

The Shuttle crew will open Discovery's cargo bay doors shortly after entering orbit. Then they will wait several hours to allow the air inside the telescope to vent into space, reducing the possibility of electrical arcing in some components when the main power is supplied to HST. After the air has had time to escape, the DOV will give the go-ahead for astronauts to switch on the main power from Discovery's aft flight deck.

Orbital verification is now officially underway and from this point on, the telescope will be under direct control of the STOCC at Goddard.

Next, the DOV will authorize Goddard mission operations to send an initial series of commands to the telescope. The telescope's communication system will respond by sending information about the telescope's condition to the STOCC. Mission operations then will confirm the telescope has received the commands. Simultaneously, the technical support team in the HOSC will evaluate the data from the telescope, verify the spacecraft is responding properly to the commands, and verify that it is in the proper configuration following launch.

Next, the OV team will begin a process called "thermal safing." Spacecraft are exposed to a huge range of temperatures in orbit, from blazing heat in direct sunlight to subfreezing temperatures during the portion of their orbit when the Earth is between the craft and the sun. Multi-layer insulation protects the telescope from the higher temperatures, but without a heating system, components left exposed to space could freeze in a short period of time. Thermal safing activates the telescope's heaters and thermostats to assure the components do not suffer from these external temperature extremes.

Toward the end of the orbiter's first day in space, the verification team will activate HST's onboard command computer and check its memory. The system which takes automatic control of the telescope in the event of loss of communications with the ground (Safe Mode system) also will be activated. While the Shuttle crew sleeps, the night shift at the STOCC will be at work, monitoring and managing systems and preparing for removal of the telescope from the cargo bay on the second day of the mission.

RELEASE OF HST

During the morning of the second day, Discovery's crew will switch on HST's internal power and deactivate the Orbiter-supplied power system. The shuttle robot arm (Remote Manipulator System) will lift the Hubble Space Telescope from the bay and suspend it above the crew cabin, with its door pointed away from the sun.

The verification team will then send the signal to unfurl HST's solar arrays almost immediately, so the telescope's six batteries can start recharging. Next, the two high gain Tracking and Data Relay Satellite System (TDRSS) antennas on the HST will be deployed.

Mission Specialists Bruce McCandless (MS1, EV1) and Kathy Sullivan (MS3, EV2) will be standing by in their spacesuits ready to go outside the spacecraft to manually provide these functions should the telescope fail to respond correctly to ground commands.

Pointing systems will be activated to control the telescope's orientation. Then, the remote manipulator arm will release its hold, and the HST will float free in orbit. Following the telescope's release, the Shuttle will back away into a parallel orbit to stand by for approximately two days in case problems occur requiring corrective action by the astronauts.

APERTURE DOOR OPENING THROUGH END OF OV/1

The telescope's aperture door must be opened next. After the OV director is confident the instruments are reading correctly and that the telescope is pointed away from the sun, Hubble's light shield door will be commanded open. Light from space will reach the telescope's precision-ground mirrors for the first time.

The OV team will gradually adjust the position of the secondary mirror until the images in the telescope's field of view become precise and sharp. Several dozen exacting adjustments in the position of the mirror may be required to further refine the focus and to compensate for the contraction of the focal plane metering truss as desorption of water vapor occurs.

All of the individual components within each instrument require specialized attention. Engineers at the STOCC will bring the instruments up to full power and make sure they are operating properly. They also will activate and evaluate the science computers which controls them. Actual fine-tuning and calibration of the instruments is part of scientific verification, but OV will not be over until the scientific instruments are fully activated and ready for use.

About 6,200 specific items of information on the telescope's status, called "telemetry points," are monitored by computer. Safe limits at any given stage of activation for each individual telemetry point have been established. Engineers from both the mission operations team at Goddard and the Marshall technical support team at Huntsville will track systems in their area of specialty. If any item does not perform within its predicted limits it will be up to the OV team to determine if the problem is in the telescope itself or in the ground system and then to decide how to resolve it. With a system as unique and complex as the HST, it is almost inevitable that some problems will arise. The purpose of OV is to catch them before they grow into situations which could hamper telescope performance.

OV/2 FIRST WEEK (BEGINS ABOUT HST DAY 45)

Engineering tests and calibrations will be performed to continue optimizing instrument settings and operations. Aperture calibrations to determine their precise locations also will be started. This set of refinements begins the process of aligning each instrument's specific aperture (a few thousandths of an arc-second field of view) within that instrument's portion of the telescope's focal-plane field-of-view. . Several instruments will monitor the effects of the South Atlantic Anomaly (SAA) on instrument performance. This data will be used to decide the high voltage turn-on sequences for the science instruments and to determine if they will be able to continue data acquisition in the SAA.

The WF/PC will perform an activity to remove any contamination that has possibly formed on the Charged Coupled Devices (CCD). Power will be applied to the Thermal Electric Coolers (TEC) and the CCDs will be cooled down to the proper operating temperature for science observations.

The FOC will perform its first external target observations on a star for the purpose of aligning its apertures.

OV/2 SECOND WEEK

The STOCC team will continue monitoring the effects of the SAA on the instruments. Instrument calibration and aperture alignment calibration tests will be continued. The Faint Object Spectrograph (FOS) will perform its first external target observations of a star to align its aperture. The spacecraft's ability to perform an accurate continuous scan will be assessed.

OV/2 THIRD WEEK

Tests and calibrations for instrument setting and aperture alignment will continue. The WF/PC starts a series of observations that will assist in defining the sharpness of images and the ability of the camera to recognize two closely spaced images.

The Goddard High Resolution Spectrograph (GHRS) will perform its first external target observations of a star to align its apertures.

Data will be taken which will be used to remove the non-uniformities from WF/PCs images.

An HST thermal stability test will be performed to characterize the telescope to establish the capability of the Fine Guidance Sensors (FGS) to perform astrometry science.

OV/2 FOURTH WEEK

Tests and calibrations of the instruments continue. The FGS to FGS alignment will be performed to provide more precise accuracy than was achieved in OV/1. The alignment will improve the ability to establish the proper science instrument (SI) calibrations. This activity, coupled with the SI fine aperture alignment calibrations, which also are performed at this time, give the spacecraft the calibration accuracy to start the more stringent calibration activities.

These processes constitute a mid-point in what might be termed the overall boresighting activities associated with determining the telescope guidance system alignment, the telescope optical truss alignment, individual instrument alignments and finally the overall system alignment.

The first FOS spectrum will be performed during the fine aperture alignment calibration and the spiral search target acquisition capability of the GHRS will be verified.

OV/2 FIFTH WEEK THROUGH END OF OV/2

Tests and calibrations of instruments continue. The optical distortion in the FGS used most often for astrometry science will be measured to provide a baseline for this FGS and the ability to do science with FGSs at the required accuracy.

The long slit spectrographic mode of the FOC will be tested for the first time.

SCIENCE VERIFICATION

After OV is completed, further calibration of the instruments and evaluations of the telescope's performance will be accomplished. This next effort will be carried out through the Space Telescope Science Institute. During this period, astronomers who contributed to the telescope's design will be given an opportunity to use the telescope to begin conducting their research. However, only after scientific verification is complete will the telescope be ready to begin its full-scale investigations.

Science Verification (SV) begins the phase of using the now-aligned telescope instruments to test their performance capabilities. These performance tests use specific astronomical targets for each instrument and will provide a gauge of the HST instrument's performance compared with results derived from previous, ground-based, observations of the same target.

The SV process is lengthy and is expected to last through early Fall, 1990. During this time, as specific instruments are tested and their performance capabilities recorded, some science observations will begin to be made even though the entire suite of instruments may not yet be declared operational.

SCIENCE OPERATIONS

Once the Hubble Space Telescope and its instruments have been fully checked out and the entire system including ground data and computational systems declared operational, HST operations will be turned over to the Space Telescope Science Institute (STScI). The institute is located on the Homewood campus of the Johns Hopkins University, Baltimore, Md.

Here, the science observing program has been developed, and it will be from here that target selection and subsequent scientific observations using HST will be performed. Although it is not necessary for the investigators to be present at the STScI during their observations, space for visiting scientists is available and a great number of astronomers are expected to take up temporary residence during the time of their observations.

COMMAND, CONTROL, OBSERVATION AND DATA SYSTEMS

The principal components of the command, control, observation and data flow for the Hubble Space Telescope are:

- HST itself with its onboard computers and data systems;
- The Tracking and Data Relay Satellites (TDRS);
- The TDRS White Sands Ground Station (WSGT);
- Domestic communications satellites;
- The Goddard Network Operations Control Center (NOCC) at GSFC;
- NASA Communications System (NASCOM) at GSFC;
- The Space Telescope Operations Control Center (STOCC) at GSFC;
- The Space Telescope Data Capture Facility (STDCF) at GSFC;
- The Space Telescope Science Institute (STScI) at Baltimore;
- The Space Telescope European Coordinating Facility (ST-ECF);
- And ultimately the astronomers and scientists who use the data.

TRACKING AND DATA RELAY SATELLITE SYSTEM

The conduit that connects HST to the science community is the Tracking and Data Relay Satellite System (TDRSS). There are two operational TDRS satellites, one situated over the Pacific Ocean (TDRS-W) and one over the Atlantic (TDRS-E). Without the TDRS system, HST would not be able to conduct its observations.

HST is the first user to simultaneously require both Multiple Access (MA) and S-band Single Access (SSA) return services from TDRSS. TDRSS will continually transfer engineering data through the MA system to the STOCC at Goddard. This service will be provided for up to 85 minutes of every HST orbit that HST is in view of one of the TDRSS satellites.

TDRSS will also provide SSA forward and return services each orbit. Realtime science and readouts of the HST onboard recorders will be collected through the SSA return service. The SSA forward service will allow the 12,000 commands executed by HST daily to be packaged and transmitted to Hubble telescope's two onboard command computers controlling the spacecraft.

HST will transmit almost three billion bits of information through the TDRSS each day. This information is received at White Sands and forwarded to the Goddard Data Capture Facility where it receives initial processing.

The data is then forwarded to the Space Telescope Science Institute. There the science data is processed, calibrated and archived. Copies of the archive tapes are provided to the European Coordinating Facility at Noordwick, the Netherlands. American and European astronomers take the data from either the Institute or the ECF back to their home institutions for detailed processing and subsequent analysis.

The White Sands Ground Terminal, located at White Sands, New Mexico, uses a pair of 16-foot (4.9 meter) diameter antennas to communicate with the TDRS-W and TDRS-E in either S- or K-bands or both. It uses separate antennas to receive and transmit the TDRSS data to other NASA controls centers using leased domestic communications satellites.

SPACE TELESCOPE OPERATIONS CONTROL CENTER

The STOCC is located on the campus of the Goddard Space Flight Center and operates as a dedicated spacecraft control center. It directly communicates, through NASCOM and WSGT and the TDRS system, to the Hubble telescope.

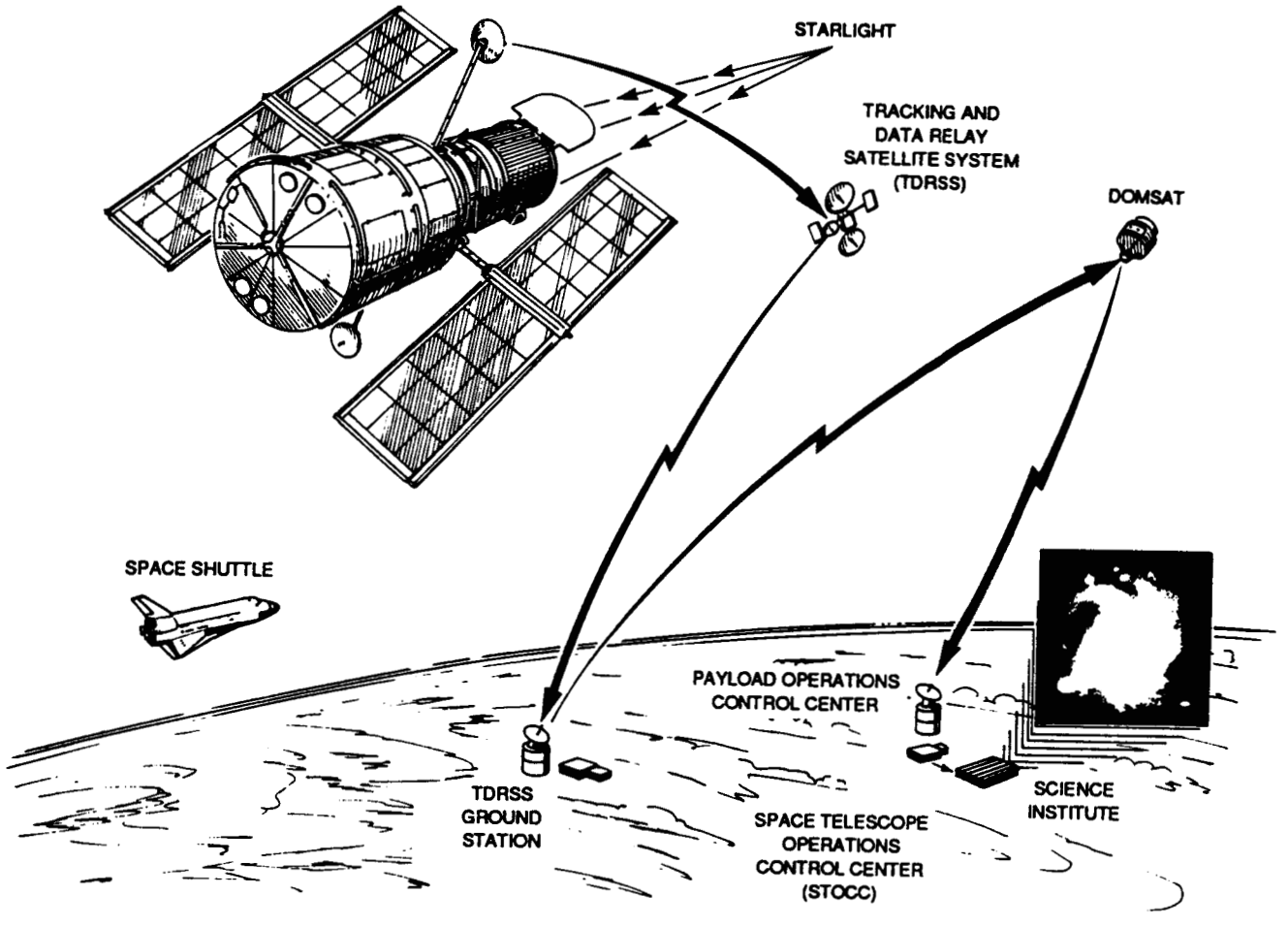
The STOCC contains a large number of redundant independent computer systems. Each of the seven computer systems operates a portion of the complex scheduling, configuring and commanding system which is required to manage and run the HST. Separate systems located at the STScI work directly with STOCC systems during realtime science operations with the HST.

Within the STOCC is a separate sub-control center called the Mission Operations Center (MOC). The MOC integrates the observing schedule for each of HST's five instruments into a master schedule which includes TDRS system availability. The MOC then originates the commands which direct the movement of the HST for coverage of the various scientific targets.

SPACE TELESCOPE SCIENCE INSTITUTE

The Institute is both the starting point for observations and the ending point for the data from those observations. In preparing an observing calendar for HST, STScI planners arrange schedules to maximize the science gain from the telescope. In all, STScI schedulers must partition some 30,000 observations within the approximately 3,000 hours available in any given 52-week observing cycle.

HST NETWORK COLLECTING DATA



To aid in this scheduling, the Institute staff developed a tool (Science Planning Interactive Knowledge Environment - SPIKE) to prepare long-range calendars. What SPIKE does is to portray graphically the various constraints imposed by HST's science instruments, the orbital parameters of the spacecraft, the allocation of observing time for the particular observation permitted under the peer review system and any special requirements of the observer. SPIKE incorporates statistical and artificial intelligence tools which then allows a best fit for the observation and the available time.

The results of this planning are then fed into the Science Planning and Scheduling System (SPSS). Here a second-by-second timeline is computer generated to describe every detail of HST's science operation. The SPSS then assembles the requests for commands which will be executed by the telescope's onboard computer systems to carryout the observation. The product of the SPSS is called a Science Mission Specifications file. This product is then transmitted from the Institute to Goddard where it passes through yet another computer system which converts the requests into the actual binary code which will be uplinked to the spacecraft.

EUROPEAN COORDINATING FACILITY

Astronomers will also have access to HST data via the Data Archive and Distribution System (DADS). The basic concept for this system is similar to that used for the International Ultraviolet Explorer (IUE) and European Exosat projects. As in these other projects, all raw and calibrated HST data, upon receipt at the STScI, will be placed in the archives and will become generally available once the original observer's proprietary period of access (normally a period of one year) has expired. A copy of the HST data archives will be transmitted and kept at the European Coordinating Facility (ST-ECF) where ESA Member-State astronomers will have full access to it. The ECF is co-located at the European Southern Observatory (ESO) located near Munich, Germany.

HUBBLE SPACE TELESCOPE SPECIFICATIONS

Main Mirror diameter	94.5 inches (2.4 meters)
Main Mirror weight	1,825 pounds (821 kilograms)
Main Mirror coating	aluminum with 0.025 magnesium fluoride over 70 % at hydrogen Lyman-Alpha
Main Mirror reflectivity	70 % at hydrogen Lyman-Alphawave lengths and greater than 85 % at visible wavelengths
Optical focal ratio	f/24
Spacecraft length	43.5 feet (13.3 meters)
Spacecraft diameter (with solar array stowed) (solar arrays deployed)	 14.0 feet (4.3 meters) 40.0 feet (12.0 meters)
Solar array size & power	7.9 by 39.9 feet (2.4 by 12.1 meters) each average 2,400 watts electricity production
Spacecraft weight	24,000 pounds (11,000 kilograms)
Orbital brightness	-3 magnitude (Venus is -4.5, Jupiter is -2.3, the Moon is -12.8)
Fine Guidance System Capabilities	Measurement of position of a star to within 0.002 arc-seconds

FUNCTIONAL DESCRIPTION OF HST OPERATIONS

Information and command flow from start to finish of an HST observation is one of the most complex and interactive activities NASA has yet undertaken in the realm of science operations.

Proposals first go the the Science Institute for review and selection. Selected proposals are then transformed into requirements against HST instrumentation and observation time. These requirements are then matched with available spacecraft capabilities and time allocations. During this process, a parallel activity matches the observation with necessary "guide stars" to serve as guidance system targets during the observation. This process matches the field of view of the observation and its target with available stars from the Guide Star Catalog(GSC). Following this process a science observation schedule is developed and sent to Goddard.

At Goddard, the science observations schedules are matched with spacecraft schedules and network tracking and data schedules. This combined schedule is then converted into HST computer commands and then sent to the the Payload Operations Control Center. From there the commands travel through the NASA communications network to White Sands and then through the TDRS system to the Hubble Space Telescope.

HST's onboard computer then executes the command sequence, moving the spacecraft into position, turning on appropriate instruments and data recording equipment and executing the observations. Data from the observations is then sent back through the TDRS and NASA communications system to Goddard. At Goddard the data is first captured in an interim data storage facility and from there is transmitted to the Institute for additional processing. Following the Institute's initial processing the data is then calibrated and both archived and distributed to the scientist whose observations it represents.

In tandem with these activities, the Goddard STOCC maintains an updated computer file on both the performance of the Hubble spacecraft and its exact orbital parameters. These are critical for the proper development of the command sequences and for inertial reference.

SCIENCE QUESTIONS HST WILL HELP ANSWER

When HST is declared operational, sometime in the fall of 1990 if the verification activities are accomplished satisfactorily, the astronomy team associated with the project will be able to finally begin their full-scale attack on some of astronomy and cosmology's toughest questions.

These questions are much the same fundamental questions which the Renaissance philosophers, the Arab and before them the Egyptian and Mayan astrologer/astronomers faced. They are simple questions: How big is the universe? How old is the universe? Newer, but still simple, questions are based on our understanding of Edwin P. Hubble's pioneering work and that of the Russian mathematician Alexander Friedman and the corroborating evidence from Arno Penzais and Robert Wilson. These questions include will the universe expand forever? What is the large scale structure of the universe? And, is the universe homogeneous on a large scale. More difficult but allied questions pertain to why normal matter (baryons) exist at all. Why is matter seemingly smoothly distributed through the universe? How did structure (galaxies) arise from a smooth homogenous fireball (big bang)?

Some of these cosmological questions give rise to further, more precise, questions. What is the Hubble Constant? Today's astronomical observations give numbers which vary by a factor of two. The Hubble Constant is a calculation of the rate at which space is expanding and is expressed in kilometers per second per megaparsec (3.26 million light years). Another question facing today's astronomers is what is the age of the universe. This is calculated by taking the inverse of the Hubble Constant . Today's numbers vary from 10 to 20 billion years of age.

What is the Deceleration Parameter? This is a measure of whether the distant galaxies are receding at a slower rate than nearby (newer) galaxies and would indicate a finite universe if the total pull of the matter in the universe were sufficient to create a large Penzias - in effect slowing down the expansion and perhaps ultimately causing a recollapse.

The expansion of the universe is controlled by the amount of matter per unit volume (density). If the density is high enough, the expansion of the universe will eventually slow and reverse. If the density is not high enough then the universe will expand forever. The measure of the density therefore becomes another critical element in our understanding the evolution of the universe.

Hubble Space Telescope will contribute to answering these questions in a variety of key observations. HST will be able to directly measure Cepheid Variable stars out to 30 million light years. These stars are the "mileposts" by which distance is measured over vast distances. An accurate measure of Cepheid Variables out to the distance of the Virgo Supercluster (2,500 galaxies amassed together) will greatly extend reliable distance measurements more than ten times than can be routinely done from ground observations. HST will find Cepheid stars in a sample of about 50 galaxies to arrive at an accurate measurement of the Hubble Constant.

The Hubble telescope also will enable astronomers to determine the age of the universe by accurately measuring stars at distances much greater than is now possible. Current cosmology has star formation occurring at a period about one billion years (or so) after the Big Bang when the temperature of the universe cooled sufficiently to allow atomic hydrogen to form and begin condensing into stars. An accurate measurement of the ages of the oldest stars will set a minimum age for the universe and therefore help constrain the Hubble Constant.

Because HST is ideally suited for the task of resolving faint galaxies at very high red shifts (a measure of recessional velocity and therefore distance), it will also help in determining the deceleration rate of distant galaxies. Before this technique can be applied, though, HST will have to add to our knowledge about such distance galaxies since current observations of these are so limited. Because such distant galaxies formed much longer ago than nearby galaxies, their intrinsic luminosity and color are not well understood which means they cannot reliably be used at the present as a "milepost." However, HST observations will contribute to the intrinsic understanding of these galaxies and subsequent observations based on new theories will allow potential use of these distant galaxies as measuring devices for studies of deceleration.

By studying the motions of galaxies within clusters out to a distance of nearly 100 million light years, HST astronomers will be able to infer the mass of galaxies - both the light matter (stellar composition) and any dark matter components. The resulting density measurements can then be scaled up to compute the mass of the universe as a whole.

Acquiring answers to cosmological questions are a major reason for the development and flight of the Hubble Space Telescope. There are, though, a great many questions in the realm of astronomy and astrophysics which HST will be addressing as well. A primary task for HST will be to trace the evolution of galaxies and clusters of galaxies. Since HST will be able to survey a volume of space nearly 100 times larger than can be surveyed with comparable resolution from the ground, HST will help give us a picture of what galaxies were like when the universe was only 35 percent of its present age.

HST's high resolution will allow a survey for extra galactic black holes. The imaging systems may be able to provide pictures of an accretion disk in nearby galaxies and HST spectrometers will enable us to measure the velocities of infalling gas thereby gauging the mass of suspected black holes.

Hubble telescope's instruments should enable a breakthrough in our understanding of synchrotron jets which extend for hundreds of thousands of light years from the center of active galactic cores. For the first time, these jets will be seen in ultraviolet light. These observations will be matched with comparable resolution views taken with radio astronomy observations.

Some of the questions pertaining to galaxies, quasi-stellar objects (quasars or QSOs) and active galactic nuclei include:

•How soon after the Big Bang did galaxies form?
•How do galaxies evolve?
•What are the dynamics of galaxies in clusters?
•Do galaxies harbor massive black holes?
•What is the dark matter in a galaxy and how is it distributed?
•How important are galactic collisions in galaxy formation?
•What is the nature of starburst phenomena?
•What is the engine which powers quasars?
•What fuels the quasar engine?
•Are there new physics to be found powering the QSO engine?
•Do quasars represent a normal stage in galactic evolution?

Stellar physics questions to be addressed by HST include studying white dwarfs. White dwarf stars are keys to our understanding the stages of late stellar evolution. HST will aid in our present understanding of this stage in a star's life and answer questions such as, can stars re-ignite after having ejected much of their mass late in their life.

At the other end of a star's life, HST will image circumstellar disks in star-forming regions to see how stellar activity affects the disks and perhaps deduce what conditions are right for planetary system formation.

Solar physics and solar system evolution are major fields of investigation for the HST astronomy team. Some of the questions HST will help answer in these fields are:

•What is the precise sequence of steps in star formation?
•What determines the rate of star formation?
•How common are jets and disk structures in other stars?
•What is the mechanism that triggers nova-like outbursts in double stars?
•What are the progenitor stars to supernovas?
•Do circumstellar disks show evidence of planet building?
•Do planets exist about other stars?
•How abundant are other solar systems?
•What is the meteorology of the outer planets and how does it change over time?
•What is the meteorology of Mars and what triggers the global summer dust storms?
•How do the surface patterns of Pluto change over time?

HUBBLE SPACE TELESCOPE PROGRAM HISTORY

Long before mankind had the ability to go into space, astronomers dreamed of placing a telescope above Earth's obscuring atmosphere. In the heydays of the Roaring Twenties, German rocket scientist and thinker Hermann Oberth described the advantages a telescope orbiting above Earth would have over those based in observatories on the ground.

Scientific instruments installed on early rockets, balloons and satellites beginning in the late 1940s produced enough exciting scientific revelations to hint at how much remained to be discovered. In the technology era spawned by the end of World War II, Dr. Lyman Spitzer, Jr., an astronomer at Princeton University, advanced the concept of an orbiting telescope greater in aperture than the recently opened 100-inch mirror instrument of the Mount Wilson Observatory.

The first official mention of an optical space telescope came in 1962, just four years after NASA was established, when a National Academy of Sciences study group recommended the development of a large space telescope as a logical extension of the U.S. space program.

This recommendation was repeated by another study group in 1965. Shortly afterwards the National Academy of Sciences established a committee, headed by Spitzer, to define the scientific objectives for a proposed Large Space Telescope with a primary mirror of about 10 feet (or 120 inches).

Meanwhile, the first such astronomical observatory--the Orbiting Astronomical Observatory-1, already had been launched successfully in 1968 and was providing important new information about the galaxy with its ultraviolet spectrographic instrument.

In 1969 the Spitzer group issued its report, but very little attention was paid to it by the astronomy community. At that time quasars, pulsars and other exotic cosmic phenomena were being discovered and many astronomers felt that time spent working towards a space telescope would be less productive than their existing time in ground-based observatories.

A 1972 National Academy of Sciences study reviewed the needs and priorities in astronomy for the remainder of that decade and again recommended a large orbiting optical telescope as a realistic and desirable goal. At that same time, NASA had convened a small group of astronomers to provide scientific guidance for several teams at the Goddard and Marshall Space Flight Centers who were doing feasibility studies for space telescopes. NASA also named the Marshall center as lead center for a space telescope program.

NASA ESTABLISHES A TELESCOPE OFFICE

NASA established in 1973 a small scientific and engineering steering committee to determine which scientific objectives would be feasible for a proposed space telescope. The science team was headed by Dr. C. Robert O'Dell, University of Chicago, who viewed the project as a chance to establish not just another spacecraft but a permanent orbiting observatory.

In 1975 the European Space Agency became involved with the project. The O'Dell group continued their worked through 1977, when NASA selected a larger group of 60 scientists from 38 institutions to participate in the design and development of the proposed Space Telescope. In 1978 Congress appropriated funds for the development of the Space Telescope.

NASA assigned responsibility for design, development and construction of the space telescope to the Marshall Space Flight Center in Huntsville, Ala. Goddard Space Flight Center, Greenbelt, Md., was chosen to lead the development of the scientific instruments and the ground control center.

Marshall selected two primary contractors to build the Hubble Space Telescope. Perkin-Elmer Corporation in Danbury, Connecticut, was chosen over Itek and Kodak to develop the optical system and guidance sensors. (Though Kodak was later contracted by P-E to provide a backup main mirror blank, which it did and which is now in storage at Kodak, Rochester, N.Y.) Lockheed Missiles and Space Company of Sunnyvale, California, was selected over Martin Marietta and Boeing to produce the protective outer shroud and the support systems module (basic spacecraft) for the telescope, as well as to assemble and integrate the finished product.

The European Space Agency agreed to furnish the spacecraft solar arrays, one of the scientific instruments and manpower to support the Space Telescope Science Institute in exchange for 15% of the observing time and access to the data from the other instruments. Goddard scientists were selected to develop one instrument, and scientists at the California Institute of Technology, the University of California at San Diego and the University of Wisconsin were selected to develop three three other instruments.

The Goddard Space Flight Center normally exercises mission control of unmanned satellites in Earth orbit. Because the Hubble Space Telescope is so unique and complex, two new facilities were established under the direction of Goddard, dedicated exclusively to scientific and engineering operation of the telescope. The facilities are the Space Telescope Operations Control Center at Goddard and the Space Telescope Science Institute, on the grounds of the Johns Hopkins University, Baltimore, Md.

The Space Telescope Operations Control Center, or STOCC as it is called, is located in a wing of Building 14 on the Goddard campus. It was established in 1985 as the ground control facility for the telescope. The scientific observing schedule developed by the Science Institute will be translated into computer commands by the control center and relayed via the Tracking and Data Relay Satellite System to the orbiting telescope. In turn, observation data will be received at the center and translated into a format usable by the Science Institute. The control center also will maintain a constant watch over the health and safety of the satellite.

The Space Telescope Science Institute was dedicated in 1983 in a new facility near the Astronomy and Physics Departments of Hopkins. It will perform the science planning for the telescope. Scientists there will select observing proposals from various astronomers, coordinate research, and generate the telescope's observing agenda. They also will archive and distribute results of the investigations. The Institute is operated under contract to NASA by the Association of Universities for Research in Astronomy (AURA) to insure academic independence. It operates under administrative direction of the Goddard center.

TELESCOPE CONSTRUCTION TAKES DECADE TO ACCOMPLISH

Construction and assembly of the space telescope was a painstaking process which spanned almost a decade. The precision-ground mirror was completed in 1981, casting and cooling of the blank by Corning Glass took nearly a year . The optical assembly (primary and secondary mirrors, optical truss and fine guidance system) was delivered for integration into the satellite in 1984. The science instruments were delivered for testing at the Goddard center in 1983. Assembly of the entire spacecraft at the Lockheed Sunnyvale facility was completed in 1985.

Launch of the Hubble Space Telescope was originally scheduled for 1986. It was delayed during the Space Shuttle redesign which followed the Challenger accident. Engineers used the interim period to subject the telescope to intensive testing and evaluation, assuring the greatest possible reliability. An exhaustive series of end-to-end tests involving the Science Institute, Goddard, the Tracking and Data Relay system and the spacecraft were performed during this time, resulting in overall improvements in system reliability.

The telescope was shipped by Air Force C5A from Lockheed, Sunnyvale, to the Kennedy Space Center, Florida in October 1989.

From 1978 through launch, the Space Telescope Program has cost $1.5 billion for the development, design, test and integration of the Hubble Space Telescope and associated spacecraft elements, $300 million for the science and engineering operations which have been supporting both the spacecraft development and the ground science operations at Goddard and the Space Telescope Science Institute, and $300 million for the design, development and testing of servicing equipment to maintain the Telescope's 15-year expected lifetime.

The Hubble Space Telescope was designed specifically to allow extensive maintenance in orbit. This is the most practical way to keep the equipment functioning and current during its 15 years or more in space with a minimum of down time. Some of the components such as batteries and solar arrays have a life expectancy shorter than 15 years and will need to be replaced from time to time. New technology will make it possible to design more sophisticated scientific instruments over the years. Several new generation instruments are already under development. In-orbit servicing allows worn parts to be replaced and new instruments to be substituted for the original equipment without the great expense, risk and delay of bringing the telescope back to Earth.

MODULAR DESIGN ENHANCES MAINTENANCE AND UPGRADABILITY

The modular design of many space telescope components means that units may be pulled out and a replacement plugged in without disturbing other systems. Doors on the exterior of the telescope allow astronauts access to these modular components, called Orbital Replacement Units. Handrails and portable foot restraints make it easier for them to move about in the weightless environment while working on the telescope. A special carrier has been designed to fit in the orbiter's cargo bay to hold replacement parts and tools.

Astronauts will visit the space telescope every three to five years on servicing missions. In case of an emergency, special contingency rescue missions have been partially developed and could be mounted between the scheduled visits.

On servicing missions, the Space Shuttle will rendezvous with the orbiting telescope. Astronauts will use the Shuttle's remote manipulator arm to pull in the observatory and mount it on a maintenance platform in the orbiter's payload bay. Astronauts will don space suits and go out into the bay to complete required maintenance. They may change out batteries or solar arrays, a computer, one of the scientific instruments, or any of the more than 50 units that can be replaced in orbit. The Shuttle also may be used to carry the telescope back to its original orbital altitude if atmospheric drag has caused it to descend.

Once the maintenance is finished, the telescope will be released once more as a free flyer. A ground team reactivation will then take place so the telescope again can resume its exploration tasks.

PROGRAM PARTICIPANTS COME FROM ALL OVER

The Hubble Space Telescope is the product of not just one group or agency, but a cooperative effort of many dedicated people from across the United States and around the world. Following is a brief summary of the institutions that are a part of the Hubble Space Telescope Program and their contributions:

NASA Headquarters Astrophysics Division, Office of Space Science and Applications, Washington, D.C.: Overall direction of the Hubble Space Telescope Program.

Marshall Space Flight Center, Huntsville, Alabama: Overall management for Hubble Space Telescope project, including supervision of design, development, assembly, pre-launch checkout and orbital verification.

Goddard Space Flight Center, Greenbelt, Maryland: Development of the scientific instruments, day-to-day operation of the telescope through its Space Telescope Operations Control Center and oversight of the Space Telescope Science Institute on the campus of Johns Hopkins University in Baltimore, Maryland.

Johnson Space Center, Houston, Texas: Orbiter and crew services during deployment and maintenance missions.

Kennedy Space Center, Florida: Pre-launch processing and Space Shuttle launch support, assuring safe delivery of the telescope to orbit.

European Space Agency: Provision of the solar arrays and Faint Object Camera, operational support at the Science Institute and maintenance of a data distribution and archive facility in Europe; in return ESA is allocated 15 percent of telescope observing time.

Universities whose staff members have made major contributions to the program include:

California Institute of Technology, Pasadena: Wide Field/Planetary Camera, Dr. James Westphal, Principal Investigator;

University of California at San Diego, La Jolla: Faint Object Spectrograph, Dr. Richard Harms, Principal Investigator (now with Applied Research Corp., Landover, Maryland);

University of Colorado, Boulder: Dr. John C. Brandt, Principal Investigator for the Goddard High Resolution Spectrograph.

University of Texas, Austin: astrometry (using the Fine Guidance System), Dr. William H. Jefferys, Principal Investigator;

University of Wisconsin, Madison: High Speed Photometer, Dr. Robert Bless, Principal Investigator.

HUNTSVILLE OPERATIONS SUPPORT CENTER HST TECHNICAL SUPPORT TEAM

A team of technical experts at NASA's Marshall Space Flight Center, Huntsville, Ala., will monitor the Hubble Space Telescope's engineering performance during its deployment and activation to confirm whether ground commands sent to the telescope have had their desired result. They will help identify problems which may arise, analyze them and recommend solutions.

The Hubble Space Telescope Technical Support Team is composed of representatives of the agencies and companies which designed and built the space telescope. They will be stationed in Marshall's Huntsville Operations Support Center during orbital verification.

The data that the telescope sends back to Earth (called "telemetry") will be simultaneously monitored by engineers in the Space Telescope Operations Control Center at Goddard and by the technical support team in Huntsville. The Goddard group will use this information to track progress in implementing the verification schedule and to make short-term operational decisions. The Marshall team will track the telescope's status and engineering performance.

Support Team Responsibilities - Technical support team engineers have three major assignments:

First, they will monitor telescope telemetry, tracking several thousand engineering measurements to determine the ongoing status of the HST and to confirm whether the telescope has responded properly to ground commands sent from the control center at Goddard. With the information they receive, they can identify problems if they arise.

Second, they will use their in-depth knowledge of the telescope and its systems to analyze problems and recommend ways to resolve them. This will include problems identified at Goddard and assigned to the Huntsville team for analysis, as well as those discovered by the technical support group and reported to the orbital verification management team at the Space Telescope Operations Control Center at Goddard.

Third, they will evaluate the performance of the space telescope to determine its true capabilities and project its future performance.

Discipline Teams - Instead of being grouped by agencies and companies, the technical support team will be organized by specialty into ten discipline or subsystem teams. Team members will include civil service and contractor employees with expert knowledge of their particular Hubble Space Telescope subsystem.

Each contractor/government team will be led by a NASA engineer charged with accomplishing the three support team goals: problem analysis and resolution, evaluation of current performance and development of long-range predictions for the capabilities of the telescope system. Engineering specialists representing the companies which developed the system will also be part of the team. Each group will be assigned a conference work area where they can monitor current or past telescope telemetry and complete problem analyses.

Engineering Console Room - The "eyes and ears" of the technical support team will be provided by personnel in the engineering console room. Engineers stationed there from each discipline team will continuously monitor "real-time" telemetry (that currently being sent from the telescope). The current value of hundreds of different measurements concerning their assigned subsystem will be displayed on their computer screens. Some types of measurements to be tracked are temperature, velocity, time, position, current and voltage.

Each measurement has been assigned a safe limit for every stage of activation. For instance, at a stated time, a designated heat sensor should register a specified temperature. If the measurement begins to move outside its safe range, the screen it appears on will flash yellow to indicate the problem. If the limits are passed even further, the screen will flash in red. About 200 measurements may be identified as critical for any point in activation or operation. When these approach the limits, a message will flash on all the terminals, regardless of discipline.

Method of Operation - Computer screens will be monitored simultaneously from the Goddard missions operations room and the Huntsville conference work areas and engineering console room. A situation requiring attention may be first detected at any of these locations.

Once a problem is identified, the discipline teams will go into action to track down its cause. First, they will determine if there is a real malfunction in the telescope or if the computer software is showing an erroneous measurement. If the problem is with the telescope itself, an approach to resolving it will be formulated between the management group at Goddard and the technical support team.

Contingency plans, designed in advance for dealing with possible problems, will be reviewed. Discipline teams will analyze current and past data from the telescope, as well as their design records. Based on that research and their in-depth knowledge of the system, the discipline teams will recommend a solution to systems engineers in the action center. The action center management group will evaluate and consolidate the recommendation and pass it on to the orbital verification management team at Goddard.

Technical Support Team Participants - The 175-member Hubble Space Telescope Technical Support Team is made up of personnel from the Marshall Space Flight Center, Lockheed Missiles and Space Company, Hughes Danbury Optical Systems (formerly Perkin-Elmer) and the European Space Agency.

HST CONTRACTORS AND SUBCONTRACTORS

Optical Telescope Assembly and Fine Guidance Sensors	Hughes Danbury Optical Systems Danbury, Conn.
Primary Mirror blank	Corning Glass Works Corning, N.Y.
Mirror Metering Truss	Boeing Airplane Co. Seattle, Wash.
Support Systems Module (spacecraft) and integration	Lockheed Missiles & Space Co. Sunnyvale, Calif.
Solar Arrays	British Aerospace Public Ltd. Co Bristol, England, U.K.
Science Instrument Command and Data Handling Computer	Fairchild Space Company Germantown, Md.
Wide Field & Planetary Camera	NASA Jet Propulsion Laboratory Pasadena, Calif.
CCD arrays for WF/PC	Texas Instruments Dallas, Texas
Faint Object Camera	Dornier GmbH Friedrichshafen, FRG
Faint Object Spectrograph	Martin Marietta Corp. Denver, Colo.
Goddard High Resolution Spectrograph	Ball Aerospace Boulder, Colo.
High Speed Photometer	University of Wisconsin Madison, Wisc.
Space Telescope Operations Control Center	Lockheed Missile & Space Co. Sunnyvale, Calif. Ford Aerospace & Comm. Co. College Park, Md.
Network and Mission Operations Support	Bendix Field Engineering Columbia, Md.
Science Operations Ground Systems	TRW, Inc. Redondo Beach, Calif.
Computer system software	Computer Sciences Corp. Silver Spring, Md.
Light Shade, Magnetic Torquer & Sensing System, Safemode Electronics	Bendix Corporation Greenbelt, Md.

PROTEIN CRYSTAL GROWTH EXPERIMENT

The Protein Crystal Growth (PCG) payload aboard STS-31 is a continuing series of experiments leading toward major benefits in biomedical technology. These experiments are expected to improve food production and lead to innovative new drugs to combat cancer, AIDS, high blood pressure, organ transplant rejection, rheumatoid arthritis and many other medical conditions.

Protein crystals, like inorganic crystals such as quartz, are structured in a regular pattern. With a good crystal, roughly the size of a grain of table salt, scientists are able to study the protein's molecular architecture.

Determining a protein crystal's molecular shape is an essential step in several phases of medical research. Once the three-dimensional structure of a protein is known, it may be possible to design drugs that will either block or enhance the protein's normal function within the body or other organisms. Though crystallographic techniques can be used to determine a protein's structure, this powerful technique has been limited by problems encountered in obtaining high-quality crystals well ordered and large enough to yield precise structural information.

Protein crystals grown on Earth are often small and flawed. The problem associated with growing these crystals is analogous to filling a sports stadium with fans who all have reserved seats. Once the gate opens, people flock to their seats and in the confusion, often sit in someone else's place. On Earth, gravity-driven convection keeps the molecules crowded around the "seats" as they attempt to order themselves. Unfortunately, protein molecules are not as particular as many of the smaller molecules and often are content to take the wrong places in the structure.

As would happen if you let the fans into the stands slowly, microgravity allows the scientist to slow the rate at which molecules arrive at their seats. Since the molecules have more time to find their spot, fewer mistakes are made, creating more uniform crystals.

Protein crystal growth experiments were first carried out by the investigating team during STS 51-D in April 1985. These prototype experiments were flown four times and were primarily designed to test vapor diffusion techniques and sample handling apparatus.

The STS-26 PCG was the first controlled or systematic experiment to grow useful crystals by vapor diffusion in microgravity within a thermal control enclosure -- the Refrigerator/Incubator Module (R/IM). This equipment was also flown aboard STS-29 and STS-32. Crystals were grown at cold temperatures for the first time on STS-32, demonstrating the potential for using longer flights to process certain proteins.

Results from these experiments have been encouraging, with high quality crystals developing from several of the samples flown. Generally, these crystals are of exceptional size and/or quality when compared to control samples grown in gravity.

During the STS-31 mission, 60 different PCG experiments will be conducted simultaneously using 12 different proteins. These proteins are:

*Isocitrate Lyase -- a target enzyme for fungicides. Better understanding of this enzyme should lead to more potent fungicdes to treat
serious crop diseases such as rice blast.

*Porcine Pancreatic Phospholipase A2 -- an enzyme associated with many human disease states including rheumatoid arthritis and septic shock. Successful structure analyses of phospholipase crystal may lead to development of drugs to treat these conditions.

*Human Gamma Interferon (GIF-D) -- an enzyme which stimulates the body's immune system and is used clinically in the treatment of cancer.

*Human Serum Transferrin -- the major iron transport protein in human serum. It transports iron from storage sites to hemoglobin synthesizing red blood cells and also is a necessary component in media for cell growth.

*Porcine Pancreatic Elastase -- an enzyme associated with the degratation of lung tissue in people suffering from emphysema. A better understanding of the enzyme's structure will be useful in studying the causes of this debilitating disease.

*Type IV Collagenase -- an enzyme obtained from snake venom (haemmioragic), it is related to collagenase secreted by invasive cancer cells.

*Canavalin -- the major storage protein of leguminous plants such as beans and peas, and a major source of dietary protein for humans and domestic animals.

*Malic Enzyme -- an enzyme isolated from nematodes. Characterizing the structural differences between it and the mammalian version could to the development of an anti-parasite drug.

*Anti-HPR Fab fragment/Fab -- the detailed structure would provide a picture of an antibody binding site which recognizes a bacterial "foreign" protein antigen. By learning what antibody binding sites look like, we may better understand how antibodies function in the immune system.

*Factor D -- an enzyme necessary for activation of a part of the immune system which plays an important role in host defense against pathogens.

*Turkey/Quail Lysozyme -- Sugars are often found associated with proteins, and these sugar/protein interactions are fundamental in all the processes of living organisms. However, very little is known about these interactions.

*Carboxyl Ester Hydrolase -- an enzyme which catalyzes the breakdown of carboxylic acid esters like those found in fats. Understanding how this enzyme functions will be valuable in learning how fats and related molecules are made and metabolized.

Shortly after achieving orbit, a crewmember will combine each of the protein solutions with other solutions containing a precipitation agent to form small droplets on the ends of double-barreled syringes positioned in small chambers. Water vapor will diffuse from each droplet to a solution absorbed in a porous reservoir that lines each chamber.

The loss of water by this vapor diffusion process will produce conditions in the droplets that cause protein crystals to grow. The samples will be processed at 22 degrees C, as on STS-26 and STS-29.

Just prior to descent, the mission specialist will photograph the droplets in the trays. Then all the droplets and any protein crystals grown will be drawn back into the syringes. The syringes then will be resealed for reentry. Upon landing, the hardware will be turned over to the investigating team for analysis.

The PCG experiments are sponsored by NASA's Office of Commercial Programs and the Microgravity Science and Applications Division with management provided through Marshall Space Flight Center (MSFC), Huntsville, Ala. Richard E. Valentine, is mission manager and Blair Herron is PCG experiment manager for Marshall.

Dr. Charles E. Bugg, director of the Center for Macromolecular Crystallography, a NASA-sponsored Center for the Commercial Development of Space located at the University of Alabama-Birmingham (UAB), is lead investigator for the PCG research team.

The STS-31 industry, university and government PCG research investigators include DuPont de Nemours & Co.; U.S. Naval Research Laboratory; BioCryst, Inc.; Schering Plough Corp.; Georgia Institute of Technology; Vertex Pharmaceuticals; Texas A&M University; University of California at Riverside; The Upjohn Co.; National Research Council of Canada; UAB Center for Macromolecular Crystallography; Laboratoire de Cristallographie et Cristallisation de Macromoles Biologiques-Faculte Nord, Marseille, France; and Eastman Kodak Co.

INVESTIGATIONS INTO POLYMER MEMBRANE PROCESSING

The Investigations into Polymer Membrane Processing (IPMP) is a middeck payload developed by the Battelle Advanced Materials Center for the Commercial Development of Space (CCDS), Columbus, Ohio. Sponsored by NASA's Office of Commercial Programs, the Battelle CCDS was formed in November 1985 to conduct research into commercially important advanced materials such as polymers, catalysts, electronic materials and superconductors. The IPMP marks the beginning of the center's work in microgravity polymer membrane processing.

Polymer membranes have been used in the separations industry for many years for such applications as desalination of water, filtration during the processing of food products, atmospheric purification, medicinal purification and dialysis of kidneys and blood.

One method of producing polymer membranes is evaporation casting. In this process, a membrane is prepared by forming a mixed solution of polymer and solvent into a thin layer -- the solution is then evaporated to dryness. The polymer membrane is left with a certain degree of porosity and can then be used for the applications described above.

Although polymer chemists do not fully understand the importance of the evaporation step in the formation of thin-film membranes, a study has demonstrated that convective flows during processing do, in fact, influence the structure of the membrane. Convective flows are a natural result of the effects of gravity on liquids or gases that are non-uniform in specific density. The microgravity of space will permit researchers to study polymer membrane casting in a convection-free environment.

The IPMP payload on STS-31 consists of two experimental units and their contents. Each IPMP unit consists of two sample cylinders connected to each other by a valve. The larger of the two cylinders is 8 inches long and 4 in. in diameter, with the smaller cylinder measuring 4.5 by 2 in. The overall dimensions of each IPMP unit are 18.6 by 3.5 by 4.41 in. The total weight of the flight hardware (both units) is approximately 17 pounds.

Before launch the larger cylinder, sealed on one end, is evacuated and sealed on the other end by closing the valve. The valve is then secured to preclude accidental opening during ground processing activities.

A thin-film polymer membrane is swelled in a solvent solution. (In this first flight experiment, the polymer -- polysulfone -- is swollen with a mixture of dimethylacetamide and acetone.) The resultant swollen gel (viscous fluid) is measured and inserted into a sample tube, which is inserted into the smaller of the two cylinders. This cylinder is sealed at ambient pressure (-14.7 psia) and attached to the other side of the valve. The procedure is repeated for the second unit. Once Discovery's on-orbit activities allow it, a crewmember will release and open the valve on each unit. Opening the valve causes the solvents in the smaller cylinder to flash-evaporate into the vacuum of the larger cylinder. The remaining thin-film polymer membrane has a porosity related to the evaporation of the solution. The system reaches an equilibrium state, which is maintained for the remainder of the flight. The minimum duration needed for adequate results is 24 hours.

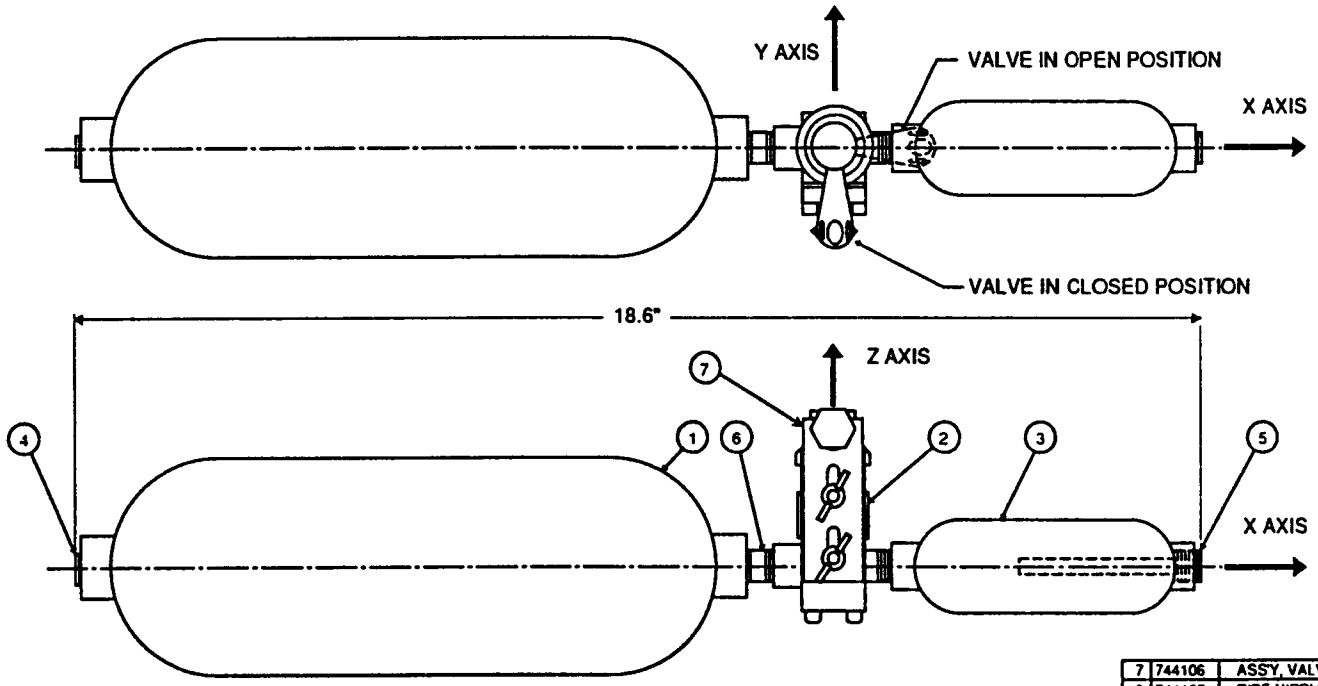
The IPMP occupies the space of a single small stowage tray (one-half of a middeck locker). The two units are positioned in foam inserts in the stowage tray. The IPMP is self-contained and requires no power from the Shuttle orbiter. Upon landing the IPMP will be returned to Battelle for analysis.

Principal investigator for the IPMP is Dr. Vince McGinniss of Battelle. Lisa A. McCauley, Associate Director of the Battelle CCDS, is program manager.

NOTES:

1. ASSEMBLE ALL PIPE FITTINGS BY WRAPPING A MINIMUM OF TWO LAYERS OF TFE TAPE ON MALE PIPE THREADS. TAPE MUST HAVE A MINIMUM DENSITY OF 1 GRAM/CC AND A MINIMUM THICKNESS OF 0.003 INCHES

2. BREAK ALL EDGES AND CORNERS 0.005 INCHES MINIMUM



7	744106	ASSY, VALVE LOCKING
6	744105	PIPE NIPPLE, CLOSE, 1/4 NPT
5	744104-2	PIPE PLUG, 1/4 NPT
4	744104-1	PIPE PLUG, 1/4 NPT
3	744103	MEMBRANE CHAMBER
2	744102	MANUAL VALVE
1	744101	VACUUM CHAMBER

Battelle
... Putting Technology to Work

505 King Avenue
Columbus, Ohio 43201-2693
Telephone (614)424-6424

TITLE

IPMP MICROGRAVITY EXPERIMENT

SIZE	CODE IDENT NO.	DIV NO	DWG. NO	REV
A		744	IPMP100	C

SCALE NONE | ACCT G0743-7501 | SHEET 1 OF 1

ENVELOPE DIMENSIONS

X: 18.6 INCHES
Y: 3.50 INCHES
Z: 4.41 INCHES

WEIGHT: 8.26 LBS

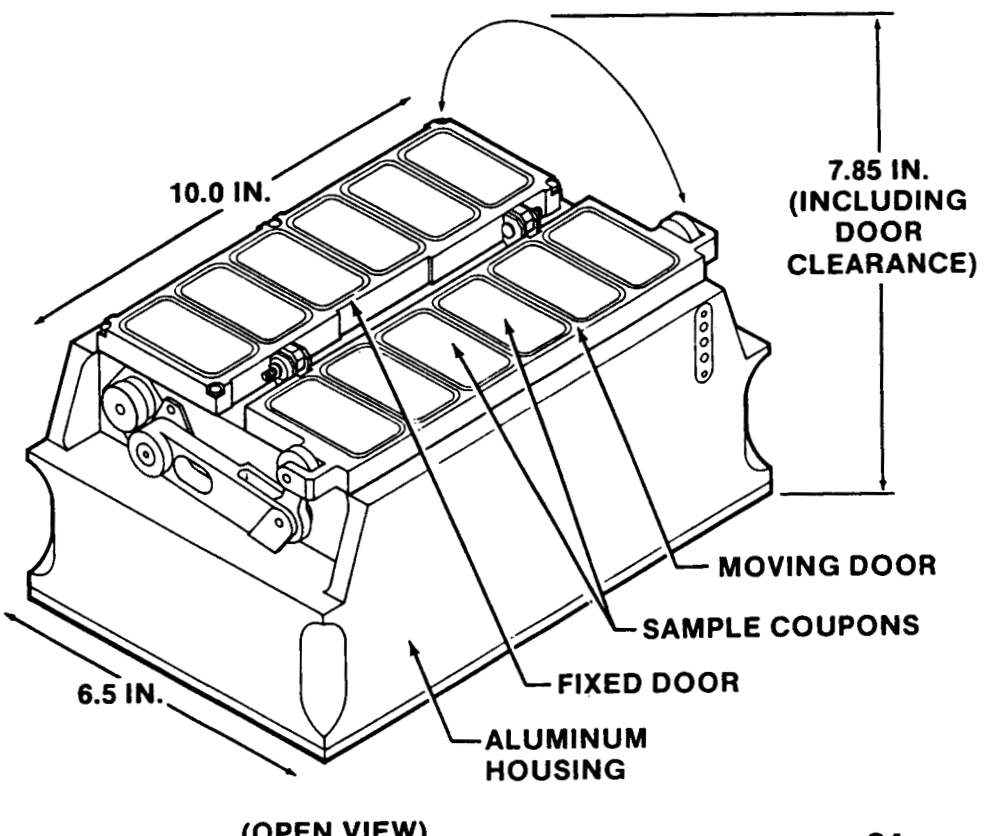
ASCENT PARTICLE MONITOR

The Ascent Particle Monitor is an automatic system mounted in Discovery's payload bay to measure particle contamination or particle detachment during the immediate prelaunch period and during ascent.

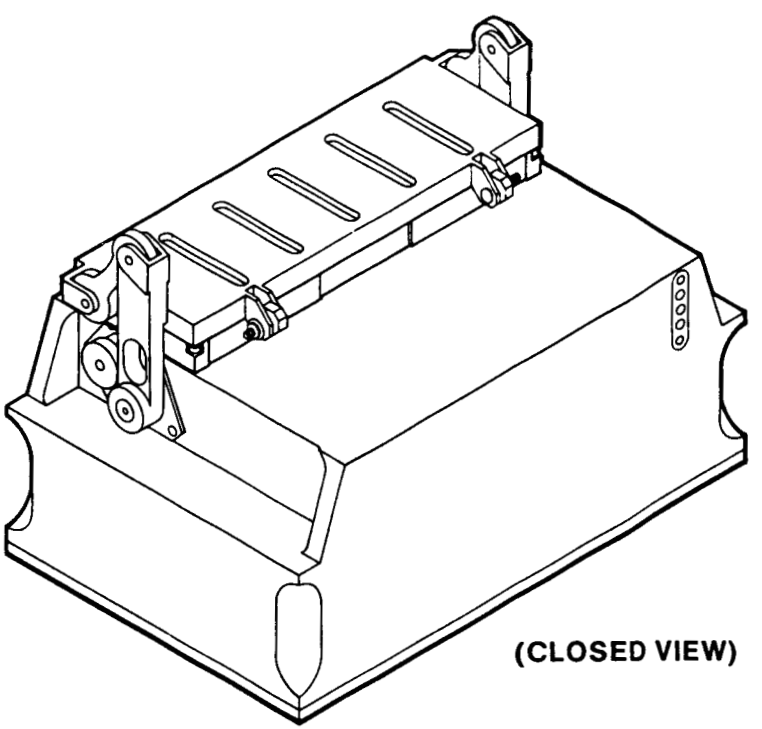
The payload consists of a small box with a fixed door and a moving door mounted in a clamshell arrangement atop an aluminum housing. Each door contains six sample coupons.

The doors are closed together preflight to protect the coupons from the environment. At a preselected time, the doors open exposing the coupons for a selected period of time. They are then closed to seal the coupons for later analysis. A motor/gearbox assembly, two battery packs and launch detection and door opening circuitry are contained within the aluminum housing.

ASCENT PARTICLE MONITOR (APM)



(OPEN VIEW)



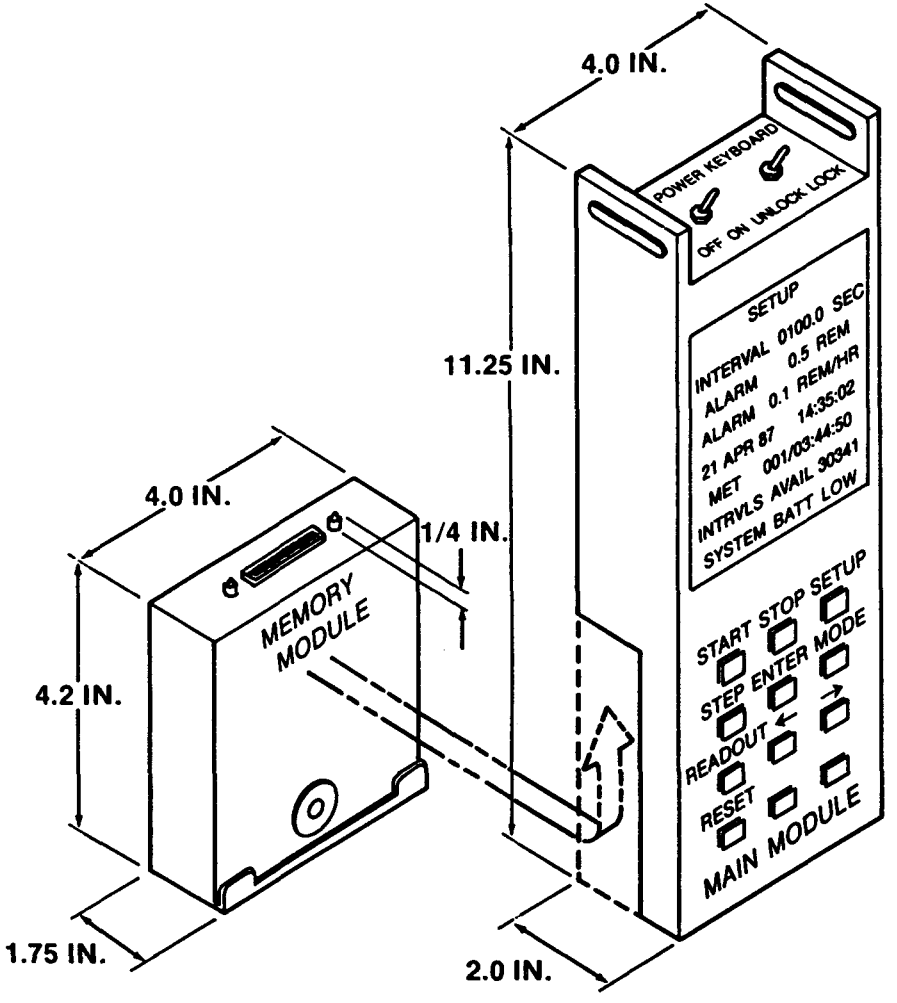
(CLOSED VIEW)

RADIATION MONITORING EXPERIMENT

The Radiation Monitoring Experiment (RME) will record both the rate and total dosage of all types of ionizing radiation (gamma ray, neutron and proton radiation). The experiment consists of a single handheld instrument with replaceable memory modules. It contains a liquid crystal display for realtime data display and a keyboard for controlling its functions.

The experiment is self-contained with two zinc-air and five AA batteries contained in each memory module and two zinc-air batteries in the main module. RME-III will be activated as soon as possible after orbit is achieved and will be programmed to operate throughout the entire mission. A crew member will enter the correct mission elapsed time upon activation and change the memory module every 2 days. All data stored in the memory modules will be analyzed at the completion of the mission.

RADIATION MONITORING EQUIPMENT CONFIGURATION



Student Science Investigation Project

"Investigation of Arc and Ion Behavior In Microgravity"

This SSIP experiment, selected in 1982, was proposed by Gregory S. Peterson, formerly of Box Elder High School, Brigham City, Utah. The experiment is designed to study the effect of weightlessness on electrical arcs.

In a normal Earth environment when electricity moves through the air between two points, air molecules become charged and form an ion path. This ion path is electrically more conductive than the surrounding air. Convective currents caused by the heating of the air around the arc tend to force the arc to rise, known as the "Jacob's ladder" effect.

In a weightless environment, convection currents cannot be created in this way, so the arc will behave differently. It is postulated that the arc shape will depend on things such as interaction between the ions, the magnetic field generated by the arc, and others. These things are not observable on Earth because the effect of convection is so much stronger than any of the other forces.

To observe the effects of free fall on an arc and to study the effects of a magnetic field on an arc without convection, Peterson's experimental apparatus consists of a sealed aluminum arc chamber box within a sealed aluminum outer box. Both boxes have a window in which a wire screen is embedded to prevent the escape of electromagnetic interference while allowing viewing and photography. Both boxes are filled with a mixture of 67% argon and 33% nitrogen to prevent the formation of ozone. Experiment results could have possible applications to materials processing in space.

Peterson is now a senior studying chemistry and biology at Utah State University. His teacher advisor is Darrel Turner, formerly with Box Elder High School. The experiment was sponsored by Thiokol Corp., with the science advice of Val King, Space Dynamics Laboratories.

IMAX

The IMAX project is a collaboration between NASA and the Smithsonian Institution's National Air and Space Museum to document significant space activities using the IMAX film medium. This system, developed by IMAX Systems Corp., Toronto, Canada, uses specially designed 70mm film cameras and projectors to record and display very high definition large-screen pictures.

During Shuttle Mission STS-31, an IMAX Cargo Bay Camera (ICBC) will be carried in the payload bay of Discovery and used to document activities associated with the deployment of the Hubble Space Telescope. The camera is mounted in the in a pressure-sealed container with a viewing window. The window has a sliding door which opens when the camera is in operation. The camera is controlled from the aft-flight deck, exposing the film through a 30mm fisheye lens.

A second IMAX camera will be flown in the mid-deck of the orbiter and will be used by the crew to collect additional material for upcoming IMAX productions.

Imax cameras previously have flown on Space Shuttle missions 41-C, 41-D and 41-G to document crew operations in the payload bay and the orbiter's middeck and flight deck along with spectacular views of Earth. Film from those missions form the basis for the IMAX production, *The Dream is Alive.*

The IMAX camera flew on STS-29 in March 1989, STS-34 in October 1989 and most recently STS-32 in January 1990. During those missions, the camera was used to gather material for an upcoming IMAX production entitled *The Blue Planet.*

Loren J. Shriver, 46, Col. USAF, will serve as Commander. Selected as an astronaut in 1978, he considers Paton, Iowa, to be his hometown and will be making his second Shuttle flight.

Shriver was Pilot for STS-51C, the eleventh shuttle flight and a DOD-dedicated mission, launched on Jan. 24, 1985. The five-member crew spent 3 days in orbit aboard Challenger.

Shriver graduated from Paton Consolidated High School in 1962 and received a bachelor of science degree in aeronautical engineering from the United States Air Force Academy in 1967. He received a master of science degree in aeronautical engineering from Purdue University in 1968.

Commissioned by the Air Force in 1967, Shriver served as a T-38 academic instructor pilot at Vance Air Force Base, Okla., from 1969-1973. He completed F-4 combat crew training in 1973 and completed a 1-year overseas assignment in Thailand in 1974. He attended the USAF Test Pilot School in 1975 and, from 1976 until his selection by NASA, served as a test pilot with the F-15 Joint Test Force at Edwards Air Force Base, Calif. Shriver has logged more than 5,000 hours in jet aircraft and flown 30 different types of single- and multi-engine aircraft.

Charles F. Bolden Jr., 44, Col. USMC, will serve as Pilot. Selected as an astronaut in 1980, he was born in Columbia, S.C., and will be making his second Shuttle flight.

Bolden was Pilot for STS-61C, a 6-day flight of Columbia launched Jan. 12, 1986. The crew deployed a SATCOM KU satellite and conducted experiments in astrophysics and materials processing. The flight culminated in a night landing at Edwards.

Bolden graduated from C.A. Johnson High School in Columbia in 1964. He received a bachelor of science degree in electrical science from the United States Naval Academy in 1968 and a master of science from the University of Southern California in 1978.

Bolden accepted a commission in the Marine Corps in 1968 and was designated a naval aviator in 1970. From 1972-1973, he flew more than 100 sorties in Vietnam while stationed in Thailand. In 1979, he graduated from the Naval Test Pilot School and was assigned to the Naval Air Test Center's systems engineering and strike aircraft test directorates, where he worked until his selection by NASA. Bolden has logged more than 4,800 hours flying time.

Bruce McCandless II, 53, Capt. USN, will serve as Mission Specialist-1 (MS-1). Selected as an astronaut in 1966, he was born in Boston, Mass., and will be making his second Shuttle flight.

McCandless was a Mission Specialist aboard Challenger on STS-41B, the tenth Shuttle flight. During the 8-day flight, the crew deployed two Hughes 376 communications satellites and McCandless completed two spacewalks, taking the shuttle's manned maneuvering unit (MMU) on its maiden voyage. The flight ended with the first landing at Kennedy Space Center.

McCandless graduated from Woodrow Wilson Senior High School, Long Beach, Calif., and received a bachelor of science degree from the U.S. Naval Academy in 1958. He received a master of science degree in electrical engineering from Stanford University in 1965 and a master's degree in business administration from the University of Houston-Clear Lake in 1987. Designated a naval aviator in 1960, he has logged more than 5,200 hours of flying time, 5,000 of them in jet aircraft.

At NASA, McCandless was a member of the astronaut support crew for the Apollo 14 mission; backup pilot of the first manned Skylab mission; and worked with development of astronaut maneuvering units for more than 10 years.

Steven A. Hawley, 39, will be Mission Specialist-2 (MS-2). Selected as an astronaut in 1978, Hawley considers Salina, Kansas, to be his hometown and will be making his third Shuttle flight.

Hawley first flew on STS-41D, the twelfth Shuttle flight and the maiden flight of Discovery, launched Aug. 30, 1984. During the 7-day flight, the six-member crew deployed the SBS-D, SYNCOM IV-2 and TELSTAR satellites. His second flight was aboard Columbia on STS-61C, on which fellow STS-31 crew member Bolden served as pilot.

Hawley graduated from Salina Central High School in 1969 and received bachelor of arts degrees in physics and astronomy from University of Kansas in 1973. He received a doctor of philosophy in astronomy and astrophysics from the University of California in 1977. At NASA, Hawley now serves as deputy chief of the Astronaut Office.

Kathryn D. Sullivan, 39, will serve as Mission Specialist-3 (MS-3). Selected as an astronaut in 1978, she considers Woodland Hills, Calif., to be her hometown and will be making her second Shuttle flight.

Sullivan flew on STS-41G, the thirteenth Shuttle flight, launched on Oct. 5, 1984. During the 8-day flight, the seven-member crew deployed Earth Radiation Budget satellite and conducted observations of Earth using the OSTA-3 flight. Sullivan conducted a 3.5-hour spacewalk to demonstrate the feasibility of refueling satellites in orbit, making her the first U.S. woman to walk in space.

Sullivan graduated from Taft High School in Woodland Hills in 1969 and received a bachelor of science degree in Earth sciences from the University of California at Santa Cruz in 1973. She received a doctorate in geology from Dalhousie University, Halifax, Nova Scotia, in 1978. At NASA, Sullivan's research interests have focused on remote sensing and planetary geology, and she made several flights in the WB-57F high-altitude research plane participating in several remote sensing projects in Alaska in 1978. She was a co-investigator on the Shuttle Imaging Radar-B experiment which flew on STS-41G.

Sullivan is an oceanography officer in the U.S. Naval Reserve and has attained the rank of Lt. Cmdr. She also is a private pilot, rated in powered and glider aircraft.

MISSION MANAGEMENT FOR HUBBLE SPACE TELESCOPE LAUNCH

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Alphonso V. Diaz - Deputy Associate Administrator
Dr. Charles J. Pellerin, Jr. - Director, Astrophysics Division
Douglas R. Broome - Chief, Observatories Development Branch
HST Program Manager
David J. Pine - HST Deputy Program Manager
Dr. Edward J. Weiler - Chief, UV/Visible Astrophysics Branch
HST Program Scientist
Dr. Geoffery Clayton - HST Deputy Program Scientist
Ralph Weeks - Observatories Servicing Program Manager

Office of Space Flight

Dr. William B. Lenoir - Associate Administrator
Joseph B. Mahon - Deputy Associate Administrator (Flight Systems)
Robert L. Crippen - Director Space Shuttle Program
Leonard E. Nicholson - Deputy Director Space Shuttle Program

Office of Space Operations

Charles T. Force - Associate Administrator
Eugene Ferrick - Director, Tracking & Data Relay Satellite Systems Division
Robert M. Hornstein - Director, Ground Networks Division

Johnson Space Center

Aaron Cohen - Director
Eugene F. Kranz - Director, Mission Operations
William D. Reeves - STS-31 Flight Director
Nellie N. Carr - STS-31 Payload Officer
Richard M. Swalin - HST Payload Integration Manager

Marshall Space Flight Center

Thomas J. Lee - Director
Fred S. Wojtalik - HST Project Manager
Jean R. Olivier - HST Deputy Project Manager
Michael M. Harrington - HST Director of Orbital Verification
William E. Taylor - HST Systems Engineering Manager
Max E. Rosenthal - HST Optical Telescope Assembly and Maintenance & Refurbishment Manager
John H. Harlow - HST Support Systems Manager
Dr. Frank Six - HST Deputy Project Scientist

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Dr. Albert Boggess - HST Project Scientist
Dr. Keith J. Kalinowski - HST Director of Science Verification
Dale L. Fahnestock - Director of Mission Operations and Data Systems Directorate

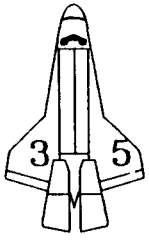
Kennedy Space Center

Forrest S. McCartney - Director
Jay Honeycutt - Director, Shuttle Management & Operations
John T. Conway - Director, Payload Management & Operations
Joanne H. Morgan - Director, Payload Project Management

European Space Agency

Robin Lawrance - ESA Project Manager
Dr. Peter Jakobsen - FOC Project Scientist
Dr. Duccio Macchetto - Chairman FOC TDT

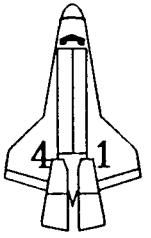
Upcoming Space Shuttle Flights



Columbia

1990
Pad 39-A

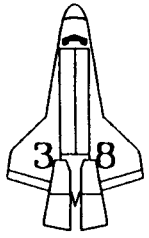
Target launch date is May 9. Mission is to use Astro-01 and Broad Band X-Ray Telescope for astronomical observations. 28.5 degrees inclination/218 st. miles. Nine days. Crew: Vance Brand;Guy Gardner;John Lounge; J.A. Hoffman; R.A.R.Parker; Ronald A. Parise; S. T. Durrance.



Discovery

1990
Pad 39-B

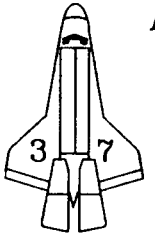
Target launch date is Oct. 5. Ulysses mission to explore sun's polar regions. 28.5 degree inclination/185 st. miles. Four days. Crew: Richard N. Richards; Robert D. Cabana; William M. Shepherd; Bruce E. Melnick; Thomas D. Akers.



Atlantis

1990
Pad 39-A

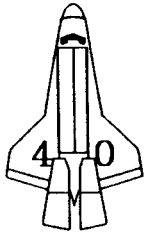
Target launch date is July 9. Department of Defense mission. Orbital parameters classified. Crew: Richard O. Covey; Frank L. Culbertson; Robert C. Springer; Carl J. Meade; Charles D. Gemar.



Atlantis

1990
Pad 39-A

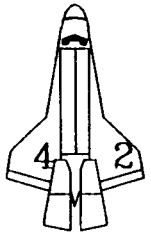
Target launch date is Nov. 1. Mission is to deploy 35,000-pound Gamma Ray Observatory. 28.5 degrees inclination/280 st. miles. Five days. Crew: S.R. Nagel; K. D. Cameron; Jerry L. Ross; Jerome Apt; Linda M. Godwin.



Columbia

1990
Pad 39-A

Target launch date is Aug. 29. SLS-01 (Space Life Science Laboratory). 39 degree inclination/ 185 st. miles. Nine days. Crew: Bryan D. O'Connor; Sidney M. Gutierrez; M. Rhea Seddon; James P. Bagian; Tamara E. Jernigan; F. Drew Gaffney; Millie Hughes-Fulford.



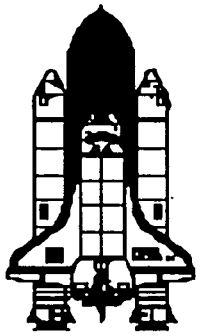
Columbia

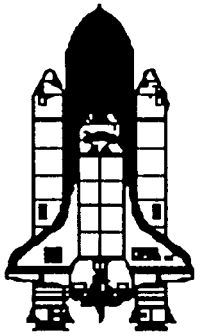
1990
Pad 39-B

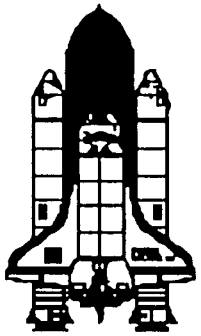
Target launch date is Dec. 12. Payload is International Microgravity Laboratory-1 housed in a Spacelab long module. 28.5 degrees inclination/190 st. miles. Nine days. Crew: R. J. Grabe; S. S. Oswald; M. L. Carter; N. E. Thagard; Wm. F. Readdy; Ulf Merbold; Roberta L. Bondar.

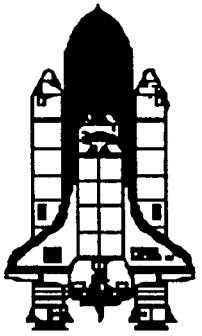
SHUTTLE FLIGHTS AS OF MARCH 1990

34 TOTAL FLIGHTS









	Challenger OV-099	Columbia OV-102	Discovery OV-103	Atlantis OV-104
12				
11				
10	51-L 1/28/86			
09	61-A 10/30/85 11/6/85	STS-32 1/9/90 1/20/90	STS-33 11/22/89 11/27/89	
08	51-F 7/29/85 8/6/85	STS-28 8/8/89 8/13/89	STS-29 3/13/89 3/18/89	
07	51-B 4/29/85 5/6/85	61-C 1/12/86 1/18/86	STS-26 9/29/88 10/3/88	
06	41-G 10/5/84 10/13/84	STS-9 11/28/83 12/8/83	51-I 8/27/85 9/3/85	STS-36 2/28/90 3/4/90
05	41-C 4/6/84 4/13/84	STS-5 11/11/82 11/16/82	51-G 6/17/85 6/24/85	STS-34 10/18/89 10/23/89
04	41-B 2/3/84 2/11/84	STS-4 6/27/82 7/4/82	51-D 4/12/85 4/19/85	STS-30 5/4/89 5/8/89
03	STS-8 8/30/83 9/5/83	STS-3 3/22/82 3/30/82	51-C 1/24/85 1/27/85	STS-27 12/2/88 12/6/88
02	STS-7 6/18/83 6/24/83	STS-2 11/12/81 11/14/81	51-A 11/7/84 11/15/84	61-B 11/26/85 12/3/85
01	STS-6 4/4/83 4/9/83	STS-1 4/12/81 4/14/81	41-D 8/30/84 9/4/84	51-J 10/3/85 10/7/85

NASA News

National Aeronautics and
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For Release:
EMBARGOED UNTIL
6 P.M. EST
March 29, 1990

RELEASE: 90-45

SCIENTISTS ADVANCE MONITORING OF GLOBAL ATMOSPHERIC TEMPERATURES

An improved technique for potentially measuring global atmospheric temperature changes and possible global warming has been developed by scientists at NASA's Marshall Space Flight Center, Huntsville, Ala., and the University of Alabama in Huntsville (UAH).

Dr. Roy Spencer, a Marshall scientist in the Earth Science and Applications Division, and Dr. John Christy, a research scientist at UAH's Johnson Research Center, evaluated temperature data gathered by the National Oceanic and Atmospheric Administration (NOAA) satellites since 1979 to monitor monthly temperature variations over the globe to a mean accuracy of 0.01 degree Centigrade, setting a standard against which future temperature trends will be measured. While future global temperature variations were not specifically addressed, the decade from 1979-1988 showed no net warming or cooling trend.

The NOAA data had been used previously for localized weather forecasting, which involved only small portions of the data. By developing a 10-year data record with global coverage, Spencer and Christy have immproved upon the surface thermometer network currently used to monitor global temperature.

Thermometers are largely restricted to populated areas, leaving the atmosphere over oceans essentially unmeasured. Earlier data used to support claims of global warming during the past 100 years have come from temperatures measured with these thermometers at the Earth's surface.

- more -

While monthly temperature variations measured by the satellites showed poor agreement with the surface thermometer data, annual averages agreed much better. Nothing could be said, however, about the validity of any long term warming trend observed by thermometers before 1979, due to the relatively short satellite data record.

The satellite data Christy and Spencer used came from microwave radiometers, developed by NASA, that each day measure the average temperature of the lowest 6 miles of the atmosphere over most of the Earth. By providing a precise record of monthly temperature changes over the Earth, this data will be extremely valuable in improving the understanding and prediction of climate changes.

The most dramatic events recorded by the satellites were the 1983 and 1987 El Ninos, when unusually warm water in the tropical Pacific Ocean affected weather conditions worldwide. Similar effects are believed to have contributed to the 1988 drought over the United States.

The two El Nino events caused global temperatures to rise more in a few months than might be forecast from several decades of "enhanced greenhouse warming," the researchers noted. Dramatic global coolings, such as that following the 1983 El Nino, were part of the unexpectedly large annual and seasonal global temperature changes observed during the 1980s.

Spencer's and Christy's research will be published Friday in Science magazine.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

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Johnson Space Center, Houston
(Phone: 713/483-5111)

For Release:
March 30, 1990

Release: 90-46

NASA CALLS FOR MIDDECK LOCKER MODULE PROPOSALS

NASA Thursday released a call for proposals to lease space and related services on a pressurized manned module to expand the Space Shuttle orbiter's middeck locker experiment capability.

Called the Commercial Middeck Augmentation Module (CMAM), the commercially-developed and owned module will ride in the orbiter payload bay when carried, be accessible through the air lock and add the volume equivalent of about 50 middeck lockers to the orbiter's capacity.

The request for proposals seeks responses from companies that can provide the module for lease by the government; physical and operational integration of the module and the experiment requirements; operator training; and data collection, processing and distribution.

Need for the additional capability emanates from NASA's Commercial Development of Space Program. In support of private sector research initiatives, NASA is offering Shuttle-based flight research opportunities through its grant program for Centers for the Commercial Development of Space. The experiments will involve breakthrough technologies in areas such as materials processing, protein crystal growth, biotechnology and fluid dynamics. The government's minimum requirements are for the lease of 175 middeck locker volume equivalents and related services to be provided over five flights beginning in 1993 and ending in 1995. An option, if proposed and exercised, will involve 25 additional middeck locker equivalents and related services to be provided on a September 1992 flight.

- more -

Deadline for the proposals is April 30. In fiscal year 1991, approximately $14 million is available for the CMAM project. The entire project is budgeted for $180 million through 1995.

The CMAM will be managed by the CMAM Project Office in the New Initiatives Office at the Johnson Space Center, Houston.

-end-

NASA news releases and other NASA information is available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. For information on CompuServe, call 1-800-848-8199 and ask for representative 176. For information on GEnie, call 1-800-638-9636.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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Headquarters, Washington, D.C.
(Phone: 202/453-8956)

For Release:
April 3, 1990

EDITORS NOTE: N90-20

ALASKA, HAWAII AND PACIFIC BASIN TO RECEIVE NASA VIDEO SERVICE

NASA's Office of Space Operations, Washington, D.C., will provide NASA Select video service to Hawaii, Alaska and the Pacific Basin, starting with the launch of Space Shuttle STS-31 mission and the deployment of the Hubble Space Telescope.

NASA will broadcast future Shuttle mission operation and possibly educational and scientific programs and public affairs events.

The STS-31 transmission will be provided by GE Americom's SATCOM F1R domestic communications satellite, located at 139 degrees west longitude. The service will be provided between 6 and 8 p.m. local Hawaiian time beginning on the day of launch (scheduled for April 10) and continuing until the conclusion of the mission. Tentatively the last transmission is scheduled for April 15 at 6 p.m.

Due to the unavailability of a single transponder, it will be necessary to change transponder access for the transmission between the 14th and the 15th of April. Transmissions on the 10th through the 14th will be on transponder 17. Transmissions beginning on the 15th will be on transponder 13.

These arrangements are for the STS-31 mission only and may change for future missions and events.

-end-

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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For Release:
April 2, 1990
2 P.M. EDT

RELEASE: 90-47

NASA AND ROCKWELL SIGN AGREEMENT FOR EDO PALLET

NASA and Rockwell International Corp., Space Transportation System Division, Downey, Calif., have signed a memorandum of agreement under which Rockwell will produce commercially a cryogenic pallet, a major element of NASA's extended duration orbiter (EDO) program to extend Space Shuttle missions up to 16 days.

The EDO cryogenic pallet holds spherical tanks of liquid hydrogen and liquid oxygen, valve panels and avionics boxes. When installed in the back of the orbiter's payload bay, the pallet will feed additional cryogenic fluids to the orbiter's electricity-generating fuel cells, thereby extending the vehicle's normal mission time from 8 to 16 days. The first EDO mission (13 days) is scheduled aboard Columbia in March 1992.

Under terms of the agreement, Rockwell will fund the design and construction of the EDO cryogenic pallet. NASA will reimburse Rockwell in 3 yearly installments after the pallet has been delivered in December 1991. NASA will offer the use of the EDO mission kit as an optional service to all Shuttle customers. Specific details of the cost to Shuttle customers are to be negotiated.

Rockwell is developing the 16-day EDO mission capability, including the cryogenic pallet and other modifications to the orbiter Columbia, under terms of a June 1988 amendment to its existing NASA/Rockwell Shuttle orbiter contract. These other modifications include a regenerative carbon dioxide removal system, a new waste collector system, additional nitrogen tanks and crew cabin improvements for equipment storage.

- end -

NASA News

National Aeronautics and
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AC 202-453-8400

Terri Sindelar
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For Release:

April 2, 1990

RELEASE: 90-48

NASA ADMINISTRATOR INVITES LOCAL STUDENTS TO SHUTTLE LAUNCHES

NASA Administrator Richard H. Truly today launched a new education program called "STAR 21 Project." Under the project, two students - "NASA Stars" - and one educator from a Washington-Baltimore metropolitan area school district will participate in an educational program culminating in a trip to the Kennedy Space Center, Fla., to attend a Space Shuttle launch.

The purpose of the "STAR 21 Project" is to help promote scientific literacy among students and educators for the 21st Century by providing a space education experience for local students age 16 or older. The visit to the Kennedy Space Center will include significant events of educational value including a tour and briefing.

In addition to the educational experience at the Kennedy Space Center, NASA will provide education materials for classroom use to the participating school(s) prior to the mission. When possible, a post-launch follow-up visit will be made to the participating school(s) by a member of the astronaut crew.

"NASA Stars" will be selected by each metro-area school district. NASA will notify districts in the Baltimore and Washington areas, on a rotating basis, of this educational opportunity and costs will be shared by NASA and the school districts.

In response to the critical science and engineering pipeline issues facing the nation, Truly wants to use NASA's unique aeronautics and space missions and facilities to help inspire science and math education in America.

To launch this new NASA education program, two "NASA Stars" and an educator from a Baltimore City school will attend the scheduled April 10 launch of Space Shuttle Columbia, the Hubble Space Telescope mission.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

Kenneth C. Atchison
Headquarters, Washington, D.C.
(Phone: 202/453-8400)

For Release:
April 9, 1990

RELEASE: 90-49

NASA ADMINISTRATOR APPOINTS ROSS AS LEWIS CENTER DIRECTOR

NASA Administrator Richard H. Truly today named Lawrence J. Ross as Director of the Lewis Research Center, Cleveland. Ross succeeds Dr. John Klineberg who becomes Director of NASA's Goddard Space Flight Center, Greenbelt, Md. The appointments are effective July 1, 1990.

Ross joined NASA in 1963 and has been Deputy Director of the center since December 1987. As Deputy Director, Ross has shared responsibility for organizing, controlling and accomplishing missions assigned to the center. "Larry Ross's deep management experience at Lewis will serve well as the NASA program meets the exciting challenges ahead," said Truly.

During most of his career, Ross has served in an executive capacity. He also has been a design and test engineer responsible for environmental testing of the Centaur launch vehicle stage and for integration of the Surveyor spacecraft with the Atlas/Centaur launch vehicle.

Ross also has undertaken several special assignments including an investigation into the failure of a Delta launch vehicle and a study of management approaches for Space Station Freedom.

He is the recipient of the NASA Exceptional Service Medal, the Presidential Rank of Meritorious Executive and the NASA Outstanding Leadership Medal. Ross and his wife, Carol, have four children.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

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NASA Headquarters, Washington, D.C.
(Phone: 202/453-8400)

For Release:
April 9, 1990

RELEASE: 90-50

GODDARD SPACE FLIGHT CENTER DIRECTOR PLANS RETIREMENT

NASA Administrator Richard H. Truly today announced the planned retirement of Dr. John W. Townsend, Director of NASA's Goddard Space Flight Center, Greenbelt, Md. Townsend's retirement will be effective June 30, 1990.

Truly paid tribute to Townsend for his long career in government service. "Jack Townsend exemplifies the best in government servants," said Truly. "He came back to NASA in June of 1987 to help out in the post-Challenger recovery period after a distinguished career in a number of positions at NASA and in other government agencies. As he departs 33 years of distinguished public service, all of us at NASA wish him the best in his years ahead."

Townsend started his government career in 1947 at the Naval Research Laboratory, Wash., D.C. In the 30 years that followed, he worked at NASA and at the National Oceanic and Atmospheric Administration where he rose to Associate Administrator. While at NASA, Townsend held several positions at Goddard Space Flight Center including Assistant Director, Space Science and Satellite Applications; Deputy Center Director; and most recently, Center Director. He was one of three U.S. principals that negotiated the first bilateral space cooperative agreements with the U.S.S.R. in 1962.

He left the federal government in 1977 to join private industry where he held a number of senior executive positions at Fairchild Industries before returning to NASA in 1987. Townsend was educated at Williams College, Williamstown, Mass.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

Kenneth C. Atchison
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For Release:
April 9, 1990

RELEASE: 90-51

TRULY APPOINTS KLINEBERG AS DIRECTOR OF GODDARD SPACE FLIGHT CENTER

NASA Administrator Richard H. Truly today announced the appointment of Dr. John Klineberg as Director of Goddard Space Flight Center, Greenbelt, Md., effective July 1, 1990. Klineberg will succeed Dr. John Townsend, who announced his planned retirement effective June 30, 1990.

Klineberg, a 20-year NASA veteran, has been Director of Lewis Research Center (LeRC), Cleveland, for the past 3 years. Truly, commenting on the appointment said, "We are fortunate to have on our management team a man of Dr. Klineberg's experience and ability to take over this challenging assignment at a time when Goddard Space Flight Center is at the heart of so many of NASA's science programs, both in flight now and planned for the next few years."

Klineberg joined NASA 20 years ago at Ames Research Center, Moffett Field, Calif. He conducted research in the area of transonic flow with emphasis on numerical methods for calculating air boundary layer separation. In 1974, he moved to NASA Headquarters, Washington, D.C., as head of the low speed aircraft branch in the Office of Aeronautics and Space Technology, eventually rising to Deputy Associate Administrator for Aeronautics and Space Technology. He was assigned to LeRC as Deputy Director in 1979 and was named Director in 1987.

Klineberg is the recipient of many prestigious awards including the NASA Outstanding Leadership Medal and the Presidential Rank of Meritorious Excellence. He was educated at Princeton University, and he received his doctorate at the California Institute of Technology. Klineberg and his wife, Anne-Marie, have three sons.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

Mary Sandy
Headquarters, Washington, D.C.
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For Release:
April 9, 1990

Don Haley
Ames-Dryden Flight Research Facility, Edwards, Calif.
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RELEASE: 90-52

X-29 SHOWS UNEXPECTED MANEUVERABILITY IN "HIGH-ALPHA" FLIGHT

The X-29 research aircraft is demonstrating in flight much better control and maneuvering qualities at high angles of attack than wind tunnel tests, computational methods and simulation models predicted.

The X-29 is an advanced technology demonstrator aircraft based at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif. The current flights, using the second of two X-29s, are investigating high-angle-of-attack characteristics and military utility of the aircraft's unique forward-swept-wing/canard configuration as part of a joint NASA-Air Force program.

Angle of attack is an engineering term that describes the angle of an aircraft's body and wings relative to its actual flight path. At extreme angles of attack, also called "high alpha," the airflow around an aircraft can produce conditions in which the wings do not create enough lift to maintain altitude.

According to Steve Ishmael, one of NASA's X-29 project pilots, the aircraft's excellent control response in the 25-45 degree angle of attack range was unexpected. "We have much more control than we thought we would have at these angles," said Ishmael. "We have good roll control and we have modest yaw control. We didn't expect this."

- more -

X-29 project officials do not yet fully comprehend why the plane responds so well in the high alpha regime. Possible explanations include interaction of the canards with vortices of air coming off the nose or some unexpected effect of the plane's forward-swept wings.

"This maneuvering capability is really a bonus for us, but we don't fully understand what is causing it," explained Gary Trippensee, X-29 project manager at Ames-Dryden. "It's something we're really looking forward to exploring."

The second X-29 reached a 50-degree angle of attack on its 23rd flight in the current research phase of the technology demonstrator program. The aircraft achieves its high alpha controllability without leading edge flaps on the wings for additional lift. It also doesn't have movable vanes on its engines to change or "vector" the direction of thrust, a capability that enhances stability and control at high Alpha.

The first X-29, which first flew in December 1984, investigated design, manufacturing and flight control concepts that have potential for development in future aircraft. It was flown 242 times, the most for any of Ames-Dryden's X-aircraft at Ames-Dryden, before it was removed from flight status.

The X-29 technology demonstrator program, funded initially by the Department of Defense Advanced Research Project Agency, is managed by the Air Force's Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, Ohio. Pilots who have flown the X-29 in the current research project are Steve Ishmael and Rogers Smith (NASA), Major Al Hoover (USAF) and Grumman test pilot Rod Womer.

- end -

NOTE TO EDITORS: A photograph is available to illustrate this release by calling 202/453-8375.

Color: 90-HC-156 B&W: 90-H-163

NASA News

National Aeronautics and
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Washington, D.C. 20546
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C.J. Fenrick
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For Release:
April 10, 1990

RELEASE: C90-o

BOEING AEROSPACE OPERATIONS AWARDED NASA CONTRACT

Boeing Aerospace Operations, Inc., Cocoa Beach, Fla. has been awarded a cost-plus-award-fee contract with an estimated value of $35.9 million for program assurance engineering support at NASA's Ames Research Center, Mountain View, Calif.

Boeing will provide reliability and quality assurance, system safety engineering, test engineering, configuration management, institutional safety and health, and environmental services for Ames.

The contract performance period will begin April 8, 1990. The contract includes two option periods: Jan. 8, 1992 through Jan. 7, 1994 and Jan. 8, 1994 through Dec. 17, 1994.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release:
April 11, 1990
Embargoed until 1 p.m. EDT

Donald G. James
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RELEASE: 90-53

NASA DEDICATES HUMAN PERFORMANCE LAB AT AMES RESEARCH CENTER

NASA today unveiled its latest research laboratory designed to answer fundamental questions about long-term human spaceflight and to expand our knowledge of human factors in the nation's increasingly crowded airspace system.

The Human Performance Research Laboratory (HPRL) at NASA's Ames Research Center, Mountain View, Calif., is the first U.S. facility designed and built to study the human role in advanced aviation and prolonged space travel. Speaking at the dedication ceremonies, Ames Center Director Dale Compton said that the HPRL "will help scientists answer questions about the relationship between humans and complex machinery. Ambitious space goals, like a lunar outpost, a Mars expedition or the National Aero-Space Plane, depend on a better understanding of how humans will interact with machines in these missions."

Among the specialized laboratories and test facilities to be included in the HPRL are those dedicated to development of virtual environment workstations, computational vision and advanced rotorcraft displays. The HPRL also will contain a unique design facility for the U.S. Army/NASA Aircrew-Aircraft Integration program.

Compton, together with special guests, also broke ground for the new $8.6 million, 59,000 sq. ft. Automation Sciences Research Facility (ASRF) in today's ceremonies. The ASRF, scheduled for completion in January 1992, will provide laboratories to conduct research and technology development in automation and artificial intelligence.

- more -

Compton said, "the decision to locate the Automation Sciences Research Facility and Human Performance Research Laboratory in a single complex recognizes that artificial intelligence (AI) and human factors research complement each other. A productive relationship between humans and machines is critical in the aerospace program. Forging the ultimate relationship between people and computers depends on shared research between AI scientists and human factors experts."

One question these laboratories will address is how humans will travel to Mars and return to Earth safely. Mars expeditions likely will depart from Space Station Freedom. During the long trip to Mars, astronauts must rely more on automated systems to make critical launch and mission operations decisions.

Complex mission objectives imposed by high technology projects like the National Aero-Space Plane, Space Station Freedom, a lunar outpost and Mars exploration require computer-controlled systems that complement highly-trained humans. Specialized facilities in the HPRL and ASRF will greatly enhance NASA's ability to develop and demonstrate computer science technologies in artificial intelligence needed to support the nation's aerospace endeavors.

-end-

NOTE TO EDITORS: Photographs are available to the media only by calling 202/453-8375.

Color: 90-HC-202 Black and White: 90-H-217

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202-453-8400

For Release:

Debbie Rivera
Headquarters, Washington, D.C.
(Phone: 202/453-8400)

April 17, 1990

RELEASE: 90-55

RICHARD NAMED DEPUTY ASSOCIATE ADMINISTRATOR FOR COMMUNICATIONS

Sue Mathis Richard was named Deputy Associate Administrator for NASA's Office of Communications. The appointment was effective April 9, 1990. She works directly with the Associate Administrator on all matters concerning the news media, public services and television development.

Before coming to NASA, Richard served as Vice President, Industry Communications for the National Cable Television Assn., overseeing press, publicity and public relations activities for the cable industry.

Previously, Richard was Florida Communications Director for the Bush-Quayle Campaign and before that Public Relations Manager for the Walt Disney World Co. Prior to that she was a Special Assistant to President Reagan and Director of Media Relations at the White House.

In addition to her extensive managerial experience, Richard has held several key positions as a journalist, including Washington television correspondent for Cox Enterprises, Inc., and cable television anchor and producer in East Lansing, Mich. She also is a former teacher, having served as an English/Communications instructor at Carl Brablec High School, Roseville, Mich.

A native of Fraser, Mich., Richard graduated from the University of Michigan with a degree in Radio/Television Communications. She now resides with her husband and 3-year old daughter in Alexandria, Va.

- end -

NASA News

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For Release:
April 19, 1990

RELEASE: 90-56

NASA ENGINEERS AND MARINE SCIENTISTS TEST BAY CLEAN-UP TECHNOLOGY

New vitality may come to the Chesapeake Bay as a result of a pilot program to improve the bay's water quality. Through a unique blend of marine science and aerodynamic research, the Virginia Institute of Marine Science (VIMS) and the NASA Langley Research Center, Hampton, Va., have joined forces in project "Water Wings."

The project began when marine scientists at VIMS confronted the problems of serious damage to marine life from low levels of oxygen in some bottom regions of the bay. This condition occurs during the summer when low saline water forms a fixed or stratified layer over denser, saltier water just as atmospheric inversions capture smog in major cities. In this case, the denser layer of water stops oxygen from moving downward. Organic decay uses up the remaining lower level oxygen creating an environment hostile to most aquatic life and impeding continuation of the food chain. Oysters are most sensitive to this problem.

In seeking a solution, Professor Don Wright, head of the VIMS Division of Geological and Benthic Oceanography, and his colleagues looked for a way to generate turbulence at the point of stratification so that the oxygen-rich water could move downward to replenish the bottom supply. Their proposals focused on the use of tornado-like flow patterns, called vortices, which form behind aircraft wings. These vortices are often observed as familiar contrails behind high flying aircraft where ice crystals make the swirling patterns visible.

- more -

After initial consultation with Dennis Bushnell, associate chief of Langley's Fluid Mechanics Division, the VIMS scientists were referred to research engineer George Greene, NASA's authority on aircraft wake vortices. Together, they began looking at the feasibility of placing an underwater aerodynamic structure, like a wing, at the stratification level. Designed to always be oriented to the tidal current, the "water wing" would use the flow of tidal water instead of air to create the same tornado-like turbulence as from an airplane. This action would break up the stratified boundary layer and achieve the desired oxygen dispersal to the bottom.

Greene says the first step of the feasibility project was to capitalize on the large amount of research done by NASA Langley in its Wake Vortex Research Program. This effort had already made significant contributions to problems involving vortex effects on airliners in congested airport environments and, in particular, in determining how vortices behave in stratified air layers. The challenge was to spin-off these results to the underwater environment in the most uncomplicated and inexpensive way. The initial effort was a simple, straight, wooden wing similar to those used on small, light aircraft. Initial testing was in the York River, Va.

The York River was chosen as the first test site because of its proximity to both agencies and the bay, and because its current, bottom contours and flow characteristics are well known to the VIMS scientists. The first deployment, which was monitored by both divers and underwater instrumentation, was very successful, according to Wright. The vortex turbulence created by the flow of water over the wing was conclusively demonstrated and, as a result, a revised, second phase configuration was prepared for testing.

That is where the project now stands. The current shape is a swept-wing design, 20-feet long with a 4-foot chord. Its testing will continue through the summer of 1990 and those results will herald a third and more ambitious stage when multiple arrays of wings will be used to treat large areas to conclude the feasibility portion of the test program.

Both Wright and Greene are optimistic about the concept as testing continues. As Greene points out, "the taxpayer has already paid for the NASA research and its highly beneficial application to commercial aviation safety. The fact that we can now use the same results in a new and exciting environmental venture makes the basic work we've done at Langley all the more worthwhile."

Wright states that the technology capitalizes on the natural energy of water currents which, "gives us greater flexibility for eventual deployment options throughout the bay." He visualizes widespread placement of the wings in virtually any part of the bay and its tributaries where there is sufficient water depth and tidal current. "Of course they'd be out of main channels and carefully marked with their own distinctive buoys," he adds.

- end -

NOTE TO EDITORS: Photographs to illustrate this release <u>for the media only</u> are available by calling 202/453-8375.

Color: 90-HC-236 (vertical), 90-HC-237 (horizontal);
Black and White: 90-H-251 (vertical), 90-H-252 (horizontal):
"Water wing" being deployed into the York River from the VIMS vessel, Bay Eagle.

Color: 81-HC-513, Black and White: 84-H-231: Illustration of vortex action over the wing of an agricultural airplane. (Series of six scenes)

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release:
April 20, 1990

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RELEASE: 90-57

NASA SCIENTIFIC INSTRUMENTS TO OBSERVE COMET AUSTIN

Two NASA sounding rockets are scheduled to be launched from the White Sands Missile Range, New Mexico, carrying scientific instruments above the Earth's atmosphere to observe the recently discovered Comet Austin (1989c1).

Both rockets are two-stage, sub-orbital Black Brant IXs. One is tentatively scheduled to be launched no earlier than April 21, during the evening, and the other no earlier than April 28, just before dawn.

The first rocketborne payload will carry Johns Hopkins University's faint object telescope (FOT) and a spectrograph to observe the comet in the far ultraviolet spectral range. Using a special Westinghouse camera, the image is sent to the ground station so that real-time maneuvers of the payload can be made for precise pointing in the sky.

The launch window for this experiment extends from April 21 through April 30, 1990. Favorable observing conditions require that the sun must be at least 23.5 degrees below the horizon and the moon must be at least 25 degrees away from Comet Austin which must be above the horizon.

The second experiment will carry a far ultraviolet spectrometer for the University of Colorado (CU). Scheduled to be launched on the morning of April 28, the payload will study the spectral emissions from Comet Austin.

-more-

According to CU's Dr. James Green, "Since comet Austin is suspected to be a "first time" comet, i.e., this is believed to be the comet's first trip into the inner solar system, the study of the concentration of its noble gases is a powerful probe of the conditions in the Oort cloud, (the region of the solar system from where comets come). For the same reason, the chemical composition of Comet Austin also is a strong indicator of the initial conditions in our solar system."

Both payloads are programmed to descend from parachutes and be recovered from the desert. The experiments then will be refurbished to make future galactic astronomy studies.

Comet Austin was discovered by an amateur comet hunter from New Zealand, Rodney R. D. Austin, on the evening of Dec. 6, 1989, when it was still far from the sun. At the time of the first rockets' observation, Comet Austin will be approximately 27 degrees from the Sun as viewed from the Earth.

The most widely accepted theory of comet composition is the "dirty snowball" model, suggested by Fred Whipple in the 1950's. As a comet approaches the sun, the water molecules at the surface of this "dirty snowball" begin to sublimate (change from a solid to a gaseous state). These rocketborne studies should provide valuable information for scientists to better understand the formation and composition of comets.

The Black Brant IX solid propellant rocket vehicle is 46 feet long and 18 inches in diameter. These scientific missions are part of the overall NASA Sounding Rocket Program managed at the Goddard Space Flight Center's Wallops Flight Facility in Virginia. This program consists of approximately 35 sounding rockets launched each year from various worldwide locations, under the sponsorship of NASA's Office of Space Science and Applications.

Dr. Paul Feldman of Johns Hopkins University is the principal investigator for the first launch; co-investigators are Drs. David Sahnow, Mel Martinez and Stephen McCandliss. For the second mission, Dr. Webster Cash is the principal investigator from the University of Colorado and Dr. Jim Green and Timothy Cook are the project scientists. Wallops Flight Facility project managers are Anel Flores and John van Overeem, respectively, for the two missions.

-end-

NASA News

National Aeronautics and
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For Release:
April 23, 1990

RELEASE: 90-58

LAUNCH DATE SET FOR CONSORT 3

The launch of Consort 3, a commercial suborbital rocket carrying 12 microgravity experiments, has been set for May 17 at 10:40 a.m. EDT, by the University of Alabama-Huntsville's (UAH) Consortium for Materials Development in Space (CMDS), a NASA Center for the Commercial Development of Space (CCDS).

Consort 3 will be launched from the Naval Ordnance Missile Test Station facilities at the U.S. Army's White Sands Missile Range (WSMR), N.M., by Space Services, Inc., Houston, using its Starfire rocket. The rocket will carry the payload to an altitude of 200 miles and will provide the experiments with 7 to 8 minutes of microgravity time.

The rocket and launch services are funded by a grant from NASA's Office of Commercial Programs, Wash., D.C. Commercial participants provided most of the funding for the payload.

The Consort 3 mission will carry experiments from three other NASA commercial development centers. They include the Center for Advanced Materials, Battelle Columbus Laboratories, Columbus, Ohio; the Center for Cell Research, Penn State University, State College; and the Center for Bioserve Space Technologies, University of Colorado, Boulder.

- more -

The UAH CMDS and the Center for Advanced Materials will perform materials science experiments, while the Penn State and Colorado centers will conduct biotechnical experiments, each using the effects of microgravity in their investigations.

This is the third commercial launch for the UAH CMDS and Space Services. Consort 1, carrying six microgravity experiments, was successfully launched on March 29, 1989.

Consort 2, launched Nov. 15, 1989, was terminated 30 seconds into the flight by the WSMR range flight safety personnel. However, the undamaged payload was recovered by parachute. The Consort 3 experiment package is essentially the same payload as the aborted Consort 2 mission.

An incident investigation board, chaired by Space Services, Inc., determined that the Consort 2 flight anomaly was caused by a mechanical failure in the MIDAS gyro platform that provides attitude reference input into the S19 boost guidance system. The loss of the platform caused the vehicle to cone, which lead to high structural loads and premature separation of the payload from the booster.

"Management and independent experts have carefully analyzed the known and other potential failure modes," said Donald (Deke) Slayton, President of Space Services. "All possible corrective actions have been taken."

- end -

NOTE TO EDITORS:

While this event is not open to the general public, news media representatives may attend. Requests for accreditation to attend the launch of Consort 3 should be submitted directly by May 10, 1990, to:

Debbie Bingham, PAO
Building 122
White Sands Missile Range, N.M. 88002-5057

Phone: 505/678-1134

Radio and television reporters planning live coverage directly from the range are required to submit their transmission frequencies to the WSMR Department of Defense Area Frequency Coordinator (505/678-5417) for approval to transmit. Requests must be received no later than May 7, 1990.

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

Mary Sandy
Headquarters, Washington, D.C.
(Phone: 202/453-2754)

For Release:
April 23, 1990

Don Haley
Ames-Dryden Flight Research Facility
Edwards Air Force Base, Calif.
(Phone: 805/258-8381)

RELEASE: 90-59

NASA F-16XL AIRCRAFT LAMINAR FLOW STUDIES SET TO BEGIN

Flight testing of the first experimental wing surface designed to improve laminar (smooth) airflow at supersonic speeds will begin this month at NASA's Ames-Dryden Flight Research Facility, Edwards Air Force Base, Calif.

The flights with a specially-modified F-16XL aircraft are part of an effort to improve high-speed performance by reducing aerodynamic drag. Current aircraft designs, both subsonic and supersonic, have turbulent airflow over a major portion of their wings. This turbulence decreases performance and reduces fuel efficiency. Good laminar flow occurs when the turbulent layers of air flowing over an aircraft wing in flight are minimized.

A thin experimental wing section containing an active suction system has been placed on the upper surface of the F-16XL's wing. Designed by Rockwell International, North American Aircraft, El Segundo, Calif., the "glove," as it's commonly called, is intended to siphon-off a portion of the layer of turbulent surface air through millions of tiny laser-cut holes in the experimental section's titanium skin and provide a greater area of smooth airflow over that section of the wing.

Researchers expect the instrumentation monitoring airflow over the experimental wing section to produce data that will validate computer codes and aid in the design of future high-speed civil transports and high-performance military aircraft.

The F-16XL is on loan to NASA from the U.S. Air Force. It is capable of flying more than 1,200 mph -- twice the speed of sound. The aircraft's delta-wing design and sustained supersonic capability make it an excellent testbed for the laminar flow studies.

- more -

The glove covers about 40 percent of the upper surface of the F-16XL's left wing and about 50 percent of the wing's leading edge. A layer of foam, up to 2 inches thick in some places and covered with fiberglass, is used as a fairing to blend the glove with the aircraft's original upper wing surface.

NASA research pilot Steve Ishmael will make about 20 flights over the next 3 months to evaluate the laminar flow wing section at supersonic speeds.

According to Louis L. Steers, manager of the F-16XL project at Ames-Dryden, NASA also plans subsequent laminar flow studies. In this second phase, the aircraft's wing will be modified with a different type of experimental wing surface designed by NASA's Langley Research Center, Hampton, Va. Initial flights in the second phase will be without a suction system. Later, a suction system will be added to the leading edge and other wing surfaces.

The first phase of the F-16XL laminar flow research project is being carried out under a cooperative agreement between NASA and Rockwell International,

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

For Release:
April 30, 1990

Mark Hess
Headquarters, Washington, D.C.
(Phone: 202/453-4164)

N90-28

EDITORS NOTE: Monthly Press Meeting Set for May 3

The NASA Associate Administrator for Space Flight Dr. William B. Lenoir will hold his monthly review with the news media on Thursday, May 3, from 3 until 5 p.m. The meeting will be held in Room 425, Building 10-B, 600 Independence Ave., S.W.

Space Shuttle Director Robert L. Crippen and Space Station Freedom Director Richard H. Kohrs also will participate in the meeting.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

For Release:

May 1, 1990

Michael Braukus
Headquarters, Washington, D.C.
(Phone: 202/453-1547)

Randee Exler
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-7277)

C90-q

GODDARD AWARDS CONTRACT FOR ENGINEERING SERVICES

NASA's Goddard Space Flight Center, Greenbelt, Md., has selected Jackson and Tull, Washington, D.C., for award of a contract under Section 8(a) of the Small Business Act. Jackson and Tull, as a subcontractor for the Small Business Administration, will provide engineering services to Goddard's Applied Engineering Division in the areas of automation and robotics and thermal and data systems.

The initial performance will be over a 2-year basic contract period and three 1-year options will be available for extension of the basic contract. The basic contract value is approximately $19 million and the total potential value over the 5-year period is approximately $63 million.

The work will be performed on site at Goddard and at additional locations in Washington, D.C.; Beltsville, Md.; Greenbelt, Md.; and Lanham, Md.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
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Mark Hess
Headquarters, Washington, D.C.
(Phone: 202/453-4164)

For Release:
May 1, 1990

Dick Young
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

Cam Martin
Langley Research Center, Hampton, Va.
(Phone: 804/864-6121)

RELEASE: 90-60

APOLLO 204 SPACECRAFT TO BE STORED AT CAPE CANAVERAL AF STATION

The Apollo 204 spacecraft, its heat shield, associated hardware and investigative data will be moved from the Langley Research Center, Hampton, Va., about May 20 and placed in permanent storage with the Challenger debris in an abandoned missile silo at Cape Canaveral Air Force Station, Fla.

Astronauts Virgil I. (Gus) Grissom, Roger B. Chaffee and Edward H. White II, perished in the Apollo 204 spacecraft fire on Jan. 27, 1967. Their deaths occurred on Launch Complex 34 at Cape Canaveral Air Force Station (CCAFS) during prelaunch tests for the first manned Apollo mission.

Apollo 204 hardware has been in storage at Langley Research Center since 1967, as directed by the Apollo 204 Review Board. Until about 10 years ago the container was kept in a low pressure nitrogen atmosphere to minimize corrosion. The container has been deteriorating and several small leaks have developed. Routine repairs were made to the container, but due to its age it cannot be effectively maintained on a continuing basis.

To recover storage area and to gain relief from the open-ended maintenance required on the storage containers, NASA decided to place the Apollo 204 hardware in permanent storage in the missile silo. The command module, heat shield, booster protective cover and 81 cartons, containing hardware and investigation data, take up about 3,300 cubic feet of storage.

- end -

Editors Note: Media who wish to cover these activities should contact the appropriate public information office listed above for accreditation and details.

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

Mark Hess
Headquarters, Washington, D.C.

(Phone: 202/453-4164)

For Release:
May 2, 1990

RELEASE: 90-61

NASA NAMES TAYLOR CHIEF SCIENTIST FOR FREEDOM SPACE STATION

William W. L. Taylor of TRW, Redondo Beach, Calif., has been named Chief Scientist for the Space Station Freedom program, Richard H. Kohrs, Director, Space Station Freedom announced today. In this position, Taylor will be the principal advocate for the space science community in the space station program.

Taylor has been with TRW since 1978, most recently as Assistant Department Manager of the Physical Sciences Department of the Applied Technology Division. He is the Principal Investigator of the Waves in Space Plasmas investigation and the High Voltage Drainage investigation carried aboard the Long Duration Exposure Facility recently returned to Earth by the Space Shuttle after almost 6 years in space.

Taylor also is the U.S. Science Coordinator for ACTIVE, an international experiment on the propagation of low frequency radio waves, and a co-investigator on the Space Experiments with Particle Accelerators investigation. He is working with TRW on the proposed Neutral Environment With Plasma Interaction Monitoring System for the Freedom space station.

Prior to joining TRW, Taylor worked with NASA where he was Program Scientist for Spacelab 1. Taylor is the third person named to the 2-year chief scientist post for the Freedom program and the first to come from industry. Previous appointees were Dr. David Black, formerly of the Ames Research Center, Mountain View, Calif., and now Director of the Lunar and Planetary Institute, Houston, and Dr. John-David Bartoe with the Naval Research Laboratory, Washington, D.C.

Taylor holds a bachelor's degree from the University of Redlands and a master of science and a doctorate from the University of Iowa.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

Dwayne C. Brown
Headquarters, Washington, D.C.

(Phone: 202/453-8956)

For Release:
May 2, 1990

RELEASE: 90-62

NINE FIRMS NAMED NASA EXCELLENCE AWARD FINALISTS

Nine finalists have been chosen for the NASA Excellence Award for Quality and Productivity for 1990. The finalists are:

* Barrios Technology, Inc., Houston

* Bendix Field Engineering Corp., Seabrook, Md.

* Boeing Computer Support Services, Program Support Communications, Marshall Space Flight Center, Huntsville, Ala.

* EG&G Florida, Inc., Kennedy Space Center, Fla.

* Grumman Technical Services Division, Titusville, Fla.

* Honeywell Inc., Space Systems Operations, Clearwater, Fla.

* Marotta Scientific Controls, Inc., Montville, N.J.

* Rockwell International Corp., Space Transportation Systems Div., Downey, Calif.

* Unisys Defense Systems, Space Transportation Operations Contract Program, Houston

Two of the finalists, Barrios and Marotta, will be evaluated in the new small business category established last year by NASA Administrator Richard H. Truly.

This small business category, while following the basic evaluation criteria for larger organizations, permits evaluators to offset the competitive advantage of larger companies with more abundant resources, personnel and funds at their disposal.

- more

George A. Rodney, NASA Associate Administrator for the Office of Safety and Mission Quality, announced the finalists after a 6-month application and review process. Finalists are picked after a review by the Excellence Award Evaluation Committee.

"The award applications are more numerous and getting better each year, making the job of the Evaluation Committee very difficult. A large number of good companies competed this year," said Joyce Jarrett, chairperson of the NASA Excellence Award Evaluation Committee.

The award process now advances to the third phase in which validation teams visit finalists' facilities to verify performance achievements and process attainments.

Following the review and recommendations of the award evaluation teams, NASA's Total Quality Management (TQM) Steering Committee, composed of Center Directors and Headquarters Associate Administrators, will make the final selection of award recipients. The NASA Administrator will announce award recipients at the seventh annual NASA/contractor conference on Oct. 24, 1990.

Key goals of the award are to internalize quality and productivity practices and TQM processes throughout NASA and the agency's contractors and to transfer performance improvement methods of the award recipients to others.

The award is administered for NASA by the American Society for Quality Control, Milwaukee, Wisc., a professional association and a worldwide leader in development, promotion and application of quality and quality-related technologies. The award recognizes NASA prime contractors, subcontractors and suppliers for outstanding achievement in quality and productivity improvement and TQM.

The recipient of the 1989 Excellence Award was Lockheed Engineering and Sciences Co. (LESCO), Houston, one of NASA's Johnson Space Center's primary contractors. Since the Excellence Awards introduction in 1985, LESCO was the first support services/mission processing contractor to win this honor.

Previous recipients of the award have been Rocketdyne Division, Rockwell International Corp., Canoga Park, Calif.; Martin Marietta Manned Space Systems Co., New Orleans; and IBM's Systms Integration Division, Houston.

- end -

NASA

SPACE SHUTTLE MISSION STS-35
PRESS KIT

MAY 1990

90-63

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Marshall Space Flight Center, Huntsville, Ala.
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NASA

National Aeronautics and
Space Administration

Washington, D.C.
RELEASE: 90-63

COLUMBIA TO FLY ASTRONOMY MISSION

Highlighting mission STS-35, the 36th flight of the Space Shuttle and 10th mission of orbiter Columbia, will be around-the-clock observations by the seven-member crew using the ultraviolet astronomy observatory (Astro) and the Broad Band X-Ray Telescope (BBXRT). Both instruments are located in Columbia's payload bay and will be operated during 12-hour shifts by the crew.

Above Earth's atmospheric interference, Astro-1 will observe and measure ultraviolet radiation from celestial objects. Astro-1 is the first in a series of missions that will make precise measurements of objects such as planets, stars and galaxies in relatively small fields of view.

Liftoff of the 10th flight of Columbia is scheduled for 12:45 a.m. EDT on May 17 from launch pad 39-A at the Kennedy Space Center, Fla. Columbia will be placed into a 218 statute (190 nautical) mile circular orbit, inclined 28.5 degrees to the equator. Nominal mission duration is expected to be 8 days 19 hours 55 minutes. Deorbit is planned on orbit 139, with landing scheduled for 8:40 p.m. EDT on May 25 at Edwards Air Force Base, Calif.

Astro-1 uses a Spacelab pallet system with an instrument pointing system and a cruciform structure for bearing the three ultraviolet instruments mounted in parallel configuration. The three instruments are the Hopkins Ultraviolet Telescope (HUT), the Wisconsin Ultraviolet Photo-polarimeter Experiment (WUPPE) and the Ultraviolet Imaging Telescope (UIT). The star tracker, which supports the instrument pointing system, also is mounted on the cruciform.

HUT will study faint astronomical objects such as quasars, active galactic nuclei and supernova remnants in the little-explored ultraviolet range below 1200 Angstroms. It consists of a mirror that focuses on an aperture of a prime focus spectrograph. Observations of the outer planets of the solar system will be made to investigate aurorae and gain insight into the interaction of each planet's magnetosphere with the solar wind.

WUPPE will measure the polarization of ultraviolet light from celestial objects such as hot stars, galactic nuclei and quasars. It uses two-mirror telescope optics in conjunction with a spectropolarimeter. This instrument will measure the polarization by splitting a beam of light into two mutually-perpendicular planes of polarization, passing the beams through a spectrometer and focusing the beams on two separate array detectors.

UIT consists of a telescope and two image intensifiers with 70 mm film transports (1000 frames each). It will acquire images of faint objects in broad ultraviolet bands in the wavelength range of 1200 to 3200 Angstroms. This experiment also will investigate the present stellar content and history of star formation in galaxies, the nature of spiral structure and non-thermal sources in galaxies.

Also in the payload bay is the Broad Band X-Ray Telescope which has two co-aligned imaging telescopes with cryogenically cooled lithium-drifted silicon detectors at each focus. Accurate pointing of the instrument is achieved by a two-axis pointing system (TAPS).

BBXRT will study various targets, including active galaxies, clusters of galaxies, supernova remnants and stars. BBXRT will directly measure the amount of energy in electron volts of each X-ray detected.

Astro observations will begin about 23 hours after Columbia has completed its maneuvering burn to circularize its orbit at 190 nautical miles. BBXRT will be activated approximately 13 hours after orbital insertion. Astro will be deactivated 12 hours before deorbit and BBXRT deactivation will be 4 hours before the deorbit burn.

Columbia's middeck will carry the Shuttle Amateur Radio Experiment (SAREX) to communicate with amateur radio stations within line-of-sight of the orbiter in voice mode or data mode. This experiment has previously flown on STS-9 and STS-51F. Also on this mission, Columbia will function as the subject for ground sensor operations as part of the Air Force Maui Optical Site (AMOS) calibration test.

Commander of the seven-member crew is Vance Brand. Pilot is Guy Gardner. STS-35 is Brand's fourth trip to space. He previously flew on the Apollo-Soyuz Test Project mission in 1975. He also commanded Shuttle missions STS-5 in November 1982 and STS-41B in February 1984. Gardner previously piloted STS-27 in December 1988.

Mission Specialists are Mike Lounge, Jeffrey Hoffman and Robert Parker. Lounge previously flew on STS-51I in August 1985 and STS-26 in September 1988. Hoffman flew as a Mission Specialist on STS-51D in April 1985. Parker's previous spaceflight experience was STS-9 in November 1983.

Payload Specialists Ronald Parise and Samuel Durrance round out the STS-35 crew. Both are making their first space flights.

-end

SUMMARY OF MAJOR ACTIVITIES

Day One
Ascent
Post-insertion
Unstow Cabin
Astro/BBXRT Activation
SAREX Setup
DSO

Day Two
Astro/BBXRT Observations
SAREX

Day Three
Astro/BBXRT Observations
SAREX

Day Four
AMOS
Astro/BBXRT Observations
SAREX

Day FIVE
AMOS
Astro/BBXRT Observations
SAREX

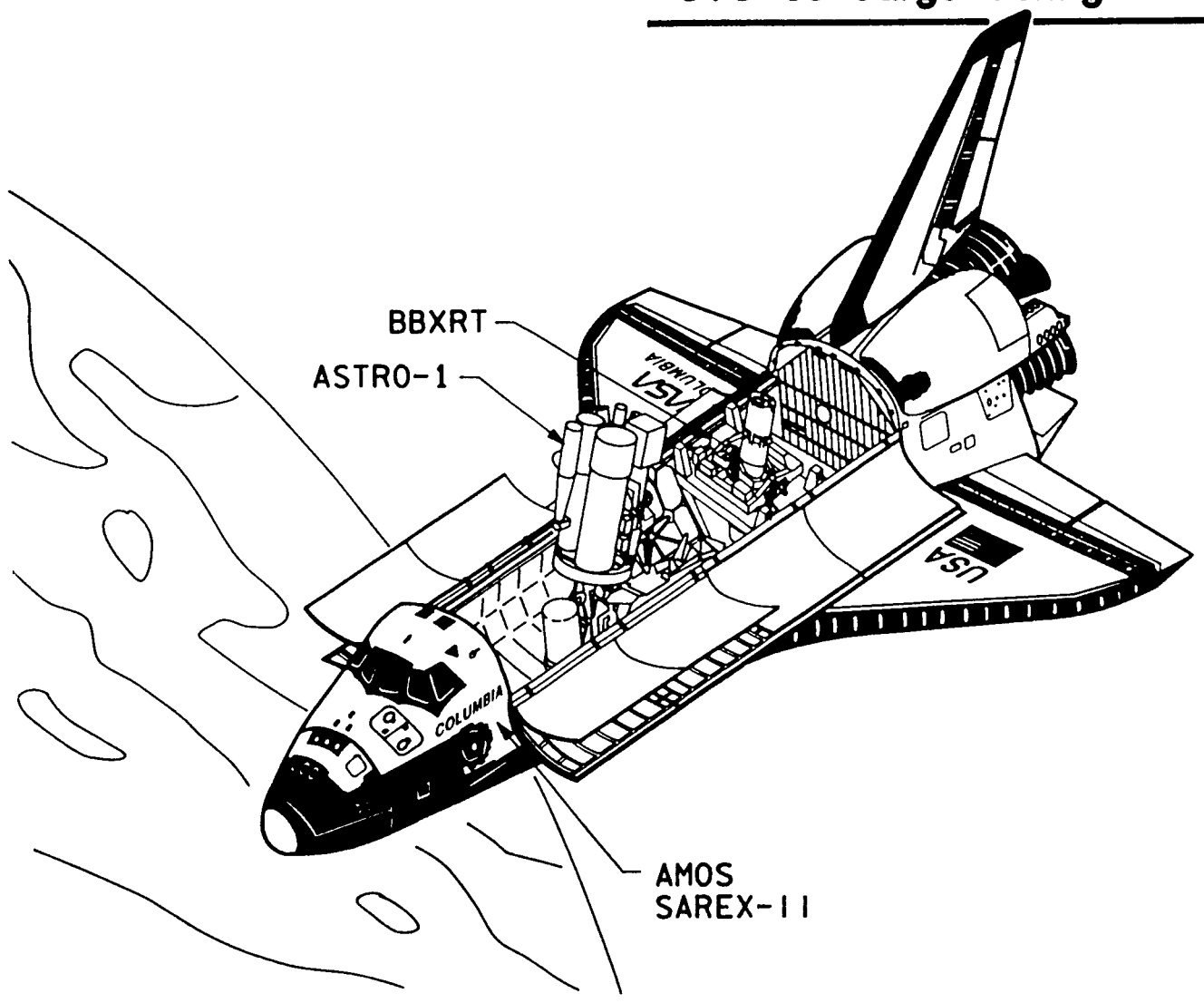
Day Six
Astro/BBXRT Observations
SAREX

Day Seven
Astro/BBXRT Observations
RCS Hotfire

Day Eight
Astro/BBXRT Observations
SAREX
DTO
FCS Checkout

Day Nine
Astro/BBXRT Observations
SAREX
SAREX Stow
Astro/BBXRT Deactivation
Cabin Stow
Deorbit Burn
Landing at Edwards AFB

Space Shuttle Program
STS-35 Cargo Configuration



STS-35 QUICK LOOK

Launch Date:	May 17, 1990
Launch Window:	12:45 a.m. - 3:09 a.m. EDT
Launch Site:	Kennedy Space Center, Fla. Launch Complex 39-A
Orbiter:	Columbia (OV-102)
Altitude:	218 statute miles (190 nm)
Inclination:	28.45
Duration:	8 days, 19 hours, 55 minutes
Landing Date/Time:	May 25, 1990, 8:40 p.m. EDT

Primary Landing Site: Edwards Air Force Base, Calif.

Abort Landing Sites: Return to Launch Site -- Kennedy Space Center, Fla.
Trans-Atlantic Abort -- Banjul, The Gambia
Abort Once Around -- Edwards AFB, Calif.

Crew

Vance D. Brand - Commander - Red/Blue Team
Guy S. Gardner - Pilot - Red Team
Jeffrey A. Hoffman - Mission Specialist 1/EV1 - Blue Team
John M. "Mike" Lounge - Mission Specialist 2/EV2 - Blue Team
Robert A.R. Parker - Mission Specialist 3 - Red Team
Samuel T. Durrance - Payload Specialist 1 - Blue Team
Ronald A. Parise - Payload Specialist 2 - Red Team

Red Team shift is approximately 10:30 p.m. -- 10:30 a.m. EDT
Blue Team shift is approximately 10:30 a.m. -- 10:30 p.m. EDT

Cargo Bay Payloads: Ultraviolet Astronomy Telescope (Astro)
Broad Band X-Ray Telescope (BBXRT)

Middeck Payloads: Air Force Maui Optical Site (AMOS)
Shuttle Amateur Radio Experiment (SAREX)

GENERAL INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, C-band located at 72 degrees west longitude, frequency 3960.0 MHz, vertical polarization, audio monaural 6.8 MHz.

The schedule for tv transmissions from the orbiter and for the change-of-shift briefings from Johnson Space Center, Houston, will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Johnson Space Center; Goddard Space Flight Center, Greenbelt, Md. and NASA Headquarters, Washington, D.C. The schedule will be updated daily to reflect changes dictated by mission operations.

TV schedules also may be obtained by calling COMSTOR, 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. Voice updates of the TV schedule may be obtained by dialing 202/755-1788. This service is updated daily at noon EDT.

Special Note to Broadcasters

In the 5 workdays before launch, short sound bites of astronaut interviews with the STS-35 crew will be available to broadcasters by calling 202/755-1788 between 8 a.m. and noon EDT.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA news center.

Briefings

An STS-35 mission press briefing schedule will be issued prior to launch. During the mission, flight control personnel will be on 8-hour shifts. Change-of-shift briefings by the off-going flight director will occur at approximately 8-hour intervals.

TRAJECTORY SEQUENCE OF EVENTS

EVENT	MET (d:h:m:s)	RELATIVE VELOCITY (fps)	MACH	ALTITUDE (ft)
Launch	00/00:00:00			
Begin Roll Maneuver	00/00:00:09	162	.14	613
End Roll Maneuver	00/00:00:16	340	.30	2,505
SSME Throttle Down to 70%	00/00:00:26	608	.54	6,759
Max. Dyn. Pressure (Max Q)	00/00:00:54	1,229	1.17	28,976
SSME Throttle Up to 104%	00/00:01:03	1,473	1.46	39,394
SRB Staging	00/00:02:05	4,203	3.87	150,267
Negative Return	00/00:03:58	6,940	7.58	309,526
Main Engine Cutoff (MECO)	00/00:08:31	24,439	22.99	360,922
Zero Thrust	00/00:08:37	24,556	22.73	363,937
ET Separation	00/00:08:49			
OMS 2 Burn	00/00:40:22			
Deorbit Burn (orbit 139)	08/18:49:47			
Landing (orbit 140)	08/19:56:07			

Apogee, Perigee at MECO: 185 x 33
Apogee, Perigee post-OMS 2: 190 x 190

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload.

Abort modes include:

- Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

- Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.; White Sands Space Harbor (Northrup Strip), N.M.; or the Shuttle Landing Facility (SLF) at Kennedy Space Center, Fla..

- Trans-Atlantic Abort Landing (TAL) -- Loss of two main engines midway through powered flight would force a landing at Banjul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

- Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines and without enough energy to reach Banjul would result in a pitch around and thrust back toward KSC until within gliding distance of the SLF.

STS-35 contingency landing sites are Edwards AFB, White Sands, Kennedy Space Center, Banjul and Ben Guerir, Moron.

PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Weight (lbs)
Orbiter Columbia empty	158,905
Ultraviolet Astronomy Telescope (Astro) (IPS, igloo and 2 pallets)	17,276
Astro Support Equipment (middeck equipment)	404
Broad Band X-Ray Telescope ((BBXRT) (including TAPS and support equipment)	8,650
Detailed Test Objectives (DTO)	274
Shuttle Amateur Radio Experiment (SAREX)	61
Total vehicle at SRB ignition	4,523,199
Orbiter and cargo at main engine cutoff	267,513
Orbiter landing weight	225,886

STS-35 PRELAUNCH PROCESSING

Kennedy Space Center shuttle processing teams began preparing Columbia for its 10th flight on January 26 when it returned to Florida following the completion of its last flight, the STS-32 LDEF retrieval mission in January.

Columbia spent about 2 and one-half months in the Orbiter Processing Facility where some 24 minor modifications were made to the orbiter's onboard systems, including the reworked nose landing gear axle and the addition of strain gauges on the Space Shuttle Main Engine high pressure oxidizer turbo pumps. Following the STS-32 flight, a debonding in the main combustion chamber was found in engine 2022 in the No. 2 position. It was replaced with a new engine, 2012, for the STS-35 flight. The other two engines will be flown in the same position as Columbia's last flight: 2024 in the No. 1 position and 2028 in the No. 3 position.

The Shuttle Entry Air Data System (SEADS) and the Shuttle Atmosphere Mass Spectrometer (SUMS) experiments, both located in the chin panel, will provide information on local surface air pressure and atmospheric density during reentry. The Shuttle Infrared Leeside Temperature Sensing (SILTS) pod camera, mounted in the top of the vertical stabilizer, was moved from viewing the port side to the centerline view of the orbiter. This camera will obtain high-resolution infrared images of the surfaces as the orbiter reenters Earth's atmosphere. These infrared maps will indicate the amount of aerodynamic heating of orbiter surfaces in flight.

Columbia was transferred to the Vehicle Assembly Building April 16 and mated to the external tank on Mobile Launcher Platform 3. During Columbia's rollout, Crawler Transporter No. 2 reached a milestone when it turned over 1,000 miles on its odometer. Rollout to Pad 39-A on April 22 occurred during the STS-31 Discovery launch countdown. Discovery was launched April 24 from Pad B, 1.65 miles north of Pad A.

Once at the pad, routine operations were performed to ready the vehicle elements for launch. The terminal countdown demonstration test was conducted April 27-28.

The launch countdown will begin about 3 days prior to the launch. During the countdown, the orbiter's onboard fuel and oxidizer storage tanks will be loaded and all orbiter systems will be prepared for flight. About 9 hours before launch, the external tank will be filled with its flight load of a half a million gallons of liquid oxygen and liquid hydrogen propellants. About 2 and one-half hours before liftoff, the flight crew will begin taking their assigned seats in the crew cabin.

Columbia is scheduled to land at Edwards AFB, Calif., KSC's landing and recovery team at NASA's Ames-Dryen Flight Research Facility will prepare the orbiter for its ferry flight back to Florida, expected to begin about 5 days after landing.

THE ASTRO-1 MISSION

Since the earliest days of astronomy, humankind has used the light from the stars to test their understanding of the universe. Now, an array of telescopes to be flown on the first Spacelab mission since 1985, will extend scientists' vision beyond the visible light to view some of the most energetic events in the universe.

Astro-1 is the first Spacelab mission devoted to a single scientific discipline -- astrophysics. The observatory will operate from within the cargo bay of Space Shuttle Columbia on the STS-35 mission. Together, four telescopes will dissect ultraviolet light and X-rays from stars and galaxies, revealing the secrets of processes that emitted the radiation from thousands to even billions of years ago. Wherever it points, Astro promises to reveal an array of information.

The Astro-1 Spacelab project is managed by NASA's Marshall Space Flight Center, Huntsville, Ala.

Seeing the Universe

Astronomy from the ground always has been hampered by the Earth's atmosphere. Even visible light is distorted and blurred by the motion of air masse, and visible light is just a small part of the radiation that virtually all objects in the sky emit. Other forms of radiation -- like cooler, low-energy infrared light and hotter, high-energy ultraviolet light and X-rays -- are largely absorbed by the atmosphere and never reach the ground.

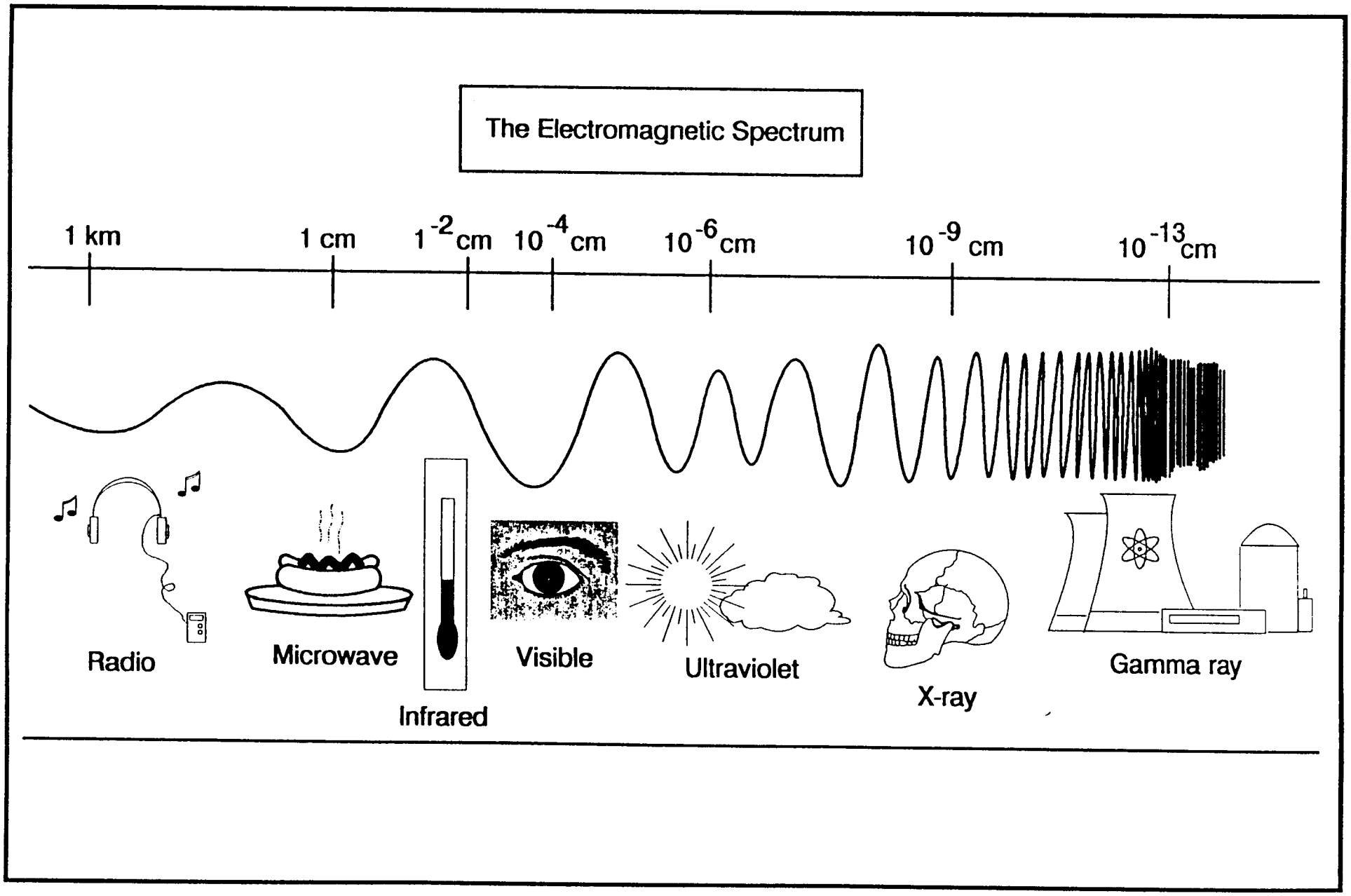
Seeing celestial objects in visible light alone is like looking at a painting in only one color. To appreciate fully the meaning of the painting, viewers must see it in all of its colors.

The Astro-1 telescopes were constructed to add some of these "colors" to scientists' view of stars and galaxies. The telescopes' perch above the veil of Earth's atmosphere in Columbia's cargo bay will allow scientists to view radiation that is invisible on the ground.

Three of Astro-1's telescopes will operate in the ultraviolet portion of the spectrum and one in the X-ray portion. One will take photographs; two will analyze the chemical composition, density and temperature of objects with a spectrograph; and the other will study the relative brightness and polarization (the study of light wavelength orientation) of celestial objects. Some sources will be among the faintest known, as faint as the glow of sunlight reflected back from interplanetary dust.

By studying ultraviolet and X-rays, astronomers can see emissions from extremely hot gases, intense magnetic fields and other high-energy phenomena that are much fainter in visible and infrared light or in radio waves -- and which are crucial to a deeper understanding of the universe.

Several space telescopes -- notably the Orbiting Astronomical Observatory-3 (Copernicus) launched in 1972, the International Ultraviolet Explorer launched in 1978 and the second High Energy Astronomy Observatory launched in 1979 --


The Electromagnetic Spectrum
1 km
1 cm
1^{-2}cm
10^{-4}cm
10^{-6}cm
10^{-9} cm
10^{-13}cm
Radio
Microwave
Infrared
Visible
Ultraviolet
X-ray
Gamma ray

opened the window in these exciting parts of the spectrum. The combined observations by Astro, the Hubble Space Telescope and ground-based observatories will provide astronomers with a more comprehensive view of the cosmos than ever before.

What Astro-1 Will "See"

The universe viewed by Astro will look strikingly different from the familiar night sky. Most stars will fade from view, too cool to emit significant ultraviolet radiation or X-rays. Yet, very young massive stars, very old stars, glowing nebulae, active galaxies and quasars will gleam brightly.

Astro will make observations in this solar system. Astro will examine the chemistry of planetary atmospheres and the interactions of their magnetic fields. The Astro observatory will study comets as they interact with light and particles from the sun to produce bright, streaming tails.

Stars

Astro will peer far beyond this solar system to study many types of stars. The sun is only one of an estimated several hundred billion stars in the galaxy. Stars like the sun are the most common type: fiery spheres of gas, about 1 million times larger in volume than Earth, with nuclear furnaces that reach temperatures of millions of degrees.

Today, current evidence indicates that the sun is a stable, middle-aged star, but some 5 billion years hence it will swell and swallow the inner planets including Earth. As a red giant, it may eject a shell of dust and gas, a planetary nebula. As the sun fades, it will collapse to an object no bigger than Earth, a dense, hot ember, a white dwarf. Astronomers predict that most stars may end their lives as white dwarfs, so it is important to study these stellar remains. White dwarfs emit most of their radiation in the ultraviolet, and one of Astro-1's main goals is to locate and examine white dwarfs in detail.

Supernova

Astro-1 instruments will locate hot, massive stars of all ages so that astronomers can study all phases of stellar evolution. Stars with 10 to 100 times more mass than the sun burn hydrogen rapidly until their cores collapse and they explode as supernovas, among the most powerful events in the universe. These stars are initially are very hot and emit mostly ultraviolet radiation.

Astro will view the recent explosion, Supernova 1987A, which spewed stellar debris into space. Supernovas forge new elements, most of which are swept away in expanding shells of gas and debris heated by the shock waves from the blast. Astro-1 will look for supernova remnants which remain visible for thousands of years after a stellar death. Astro-1's ultraviolet and X-ray telescopes will provide information on element abundances, the physical conditions in the expanding gas and the structure of the interstellar medium.

Neutron Stars, Pulsars, Black Holes

After a supernova explosion, the stellar core sometimes collapses into a neutron star, the densest and tiniest of known stars, with mass comparable to the sun compacted into an area the size of a large city. Matter can become so dense that a sugar cube of neutron star material would weigh 100 million tons.

Sometimes neutron stars are pulsars that emit beacons of radiation and appear to blink on and off as many as hundreds of times per second because they spin so rapidly. Scientists have theorized that some stars may collapse so far that they become black holes, objects so dense and gravitationally strong that neither matter nor light escape. Astro will look for the ultraviolet radiation and X-rays thought to be produced when hot, whirling matter is drawn into a black hole.

Star Systems

Few stars live in isolation; most are found in pairs or groups. Some stellar companions orbit each other and often pass so close that mass is transferred from one star to the other, producing large amounts of ultraviolet and X-ray radiation which Astro-1's four telescopes are designed to study. These binary star systems may consist of various combinations of objects including white dwarfs, neutron stars, and black holes.

Star Clusters

Stars may congregate in star clusters with anywhere from a few to millions of members. Often, there are so many stars in the core of a cluster, it is impossible to distinguish the visible light from individual stars. Because they shine brightly in the ultraviolet, Astro-1 can isolate the hot stars within clusters.

The clusters are excellent laboratories for studying stellar evolution because the stars residing there formed from the same material at nearly the same time. However, within a single cluster, stars of different masses evolve at different rates.

Stellar evolution can be studied by looking at clusters of different ages. Each cluster of a given age provides a snapshot of what is happening as a function of stellar mass. By examining young clusters (less than 1 million years old) and comparing them to old clusters (1 billion years old), scientists can piece together what happens over a long time.

Interstellar Medium

The space between stars is filled with dust and gas, some of which will condense to become future stars and planets. This interstellar medium is composed chiefly of hydrogen with traces of heavier elements and has a typical density of one atom per thimbleful of space. Astro-1 will be able to measure the properties of this material more accurately by studying how it affects the light from distant stars.

For the most part, the interstellar medium is relatively cool, but it includes pockets of hot matter as well. Dense clouds of dust that surround stars and scatter and reflect light are called reflection nebulae. These are often illuminated by hot, young stars in stellar nurseries hidden within the clouds. Ultraviolet observations will reveal the features of stars hidden by the dust as well as the size and composition of the dust grains.

Other Galaxies

Beyond the Milky Way are at least a hundred billion more galaxies, many with hundreds of billions of stars. They contain most of the visible matter in the universe and are often found in clusters of galaxies that have tens to thousands of members. X-ray and ultraviolet emission will allow scientists to study the hottest, most active regions of these galaxies as well as the intergalactic medium, the hot gas between the galaxies in a cluster.

Galaxies have a variety of shapes and sizes: gigantic spirals like the Milky Way, egg-shaped elliptical and irregular shapes with no preferred form. Astro will survey the different types of galaxies and study their evolution. The nearby galaxies will appear as they were millions of years ago, and Astro will see the most distant ones as they were billions of years ago. By comparing these galaxies, scientists can trace the history of the universe.

Quasars

Some galaxies are in the process of violent change. Such active galaxies have central regions (nuclei) that emit huge amounts of energy; their ultraviolet and X-ray emission may help us identify their source of power. Astro-1's ultraviolet and X-ray telescopes will detect quasars, very distant compact objects that radiate more energy than 100 normal galaxies.

Quasars may be the nuclei of ancient active galaxies. Strong X-ray and ultraviolet radiation arising in the central cores of these powerful objects may help scientists discover what these objects really are.

This overview is the known universe today, but many of these ideas are only predictions based on theory and a few observations. Scientists still lack the definitive observations needed to confirm or refute many of these theories. Scientists do not know the exact size of the universe or its age. Scientists have never definitely seen a black hole, and they continue to question the nature of quasars.

To understand these mysteries, scientists need to see the universe in all its splendor. Astro is part of NASA's strategy to study the universe across the electromagnetic spectrum, in all wavelengths.

THE ASTRO-1 OBSERVATORY

The Astro-1 observatory is a compliment of four telescopes. Though each instrument is uniquely designed to address specific questions in ultraviolet and X-ray astronomy, when used in concert, the capability of each is enhanced. The synergistic use of Astro-1's instruments for joint observations serves to make Astro-1 an exceptionally powerful facility. The Astro-1 observatory has three ultraviolet-sensitive instruments:

o Hopkins Ultraviolet Telescope (HUT) uses a spectrograph to examine faint astronomical objects such as quasars, active galactic nuclei and normal galaxies in the far ultraviolet.

o Ultraviolet Imaging Telescope (UIT) will take wide-field-of-view photographs of objects such as hot stars and galaxies in broad ultraviolet wavelength bands.

o Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE) will study the ultraviolet polarization of hot stars, galactic nuclei and quasars.

These instruments working together will make 200 to 300 observations during the STS-35 mission. The Astro ultraviolet telescopes are mounted on a common pointing system in the cargo bay of the Space Shuttle. The grouped telescopes will be pointed in the same direction at the same time, so simultaneous photographs, spectra and polarization studies will be available for each object observed. The telescopes will be operated by Columbia's crew.

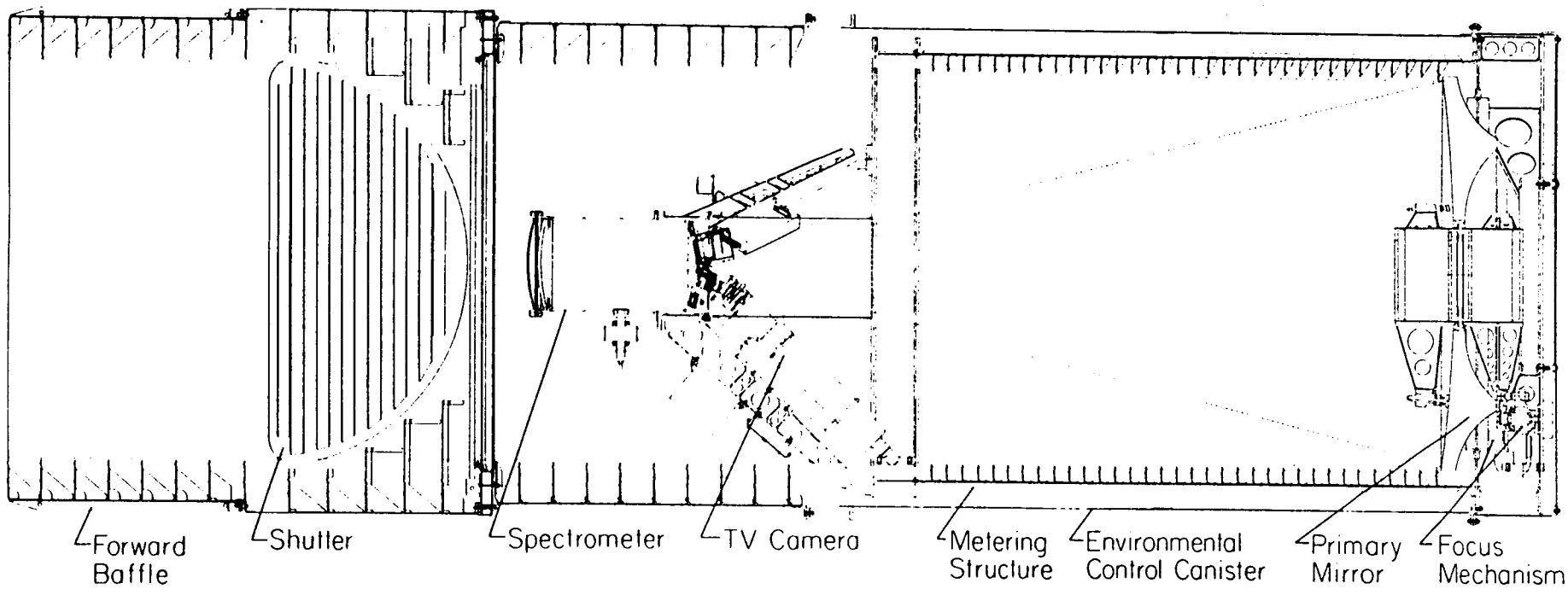
A fourth Astro instrument, the Broad Band X-Ray Telescope (BBXRT), will view high-energy objects such as active galaxies, quasars and supernovas. This telescope is mounted on a separate pointing system secured by a support structure in the cargo bay.

For joint observations, BBXRT can be aligned with the ultraviolet telescopes to see the same objects, but it also can be pointed independently to view other X-ray sources. BBXRT will be operated remotely by ground controllers. Since the ultraviolet telescopes and the X-ray telescope are mounted on different support structures, they can be reflown together or separately.

The Hopkins Ultraviolet Telescope

The Hopkins Ultraviolet Telescope is the first major telescope capable of studying far ultraviolet (FUV) and extreme ultraviolet (EUV) radiation from a wide variety of objects in space. HUT's observations will provide new information on the evolution of galaxies and quasars, the physical properties of extremely hot stars and the characteristics of accretion disks (hot, swirling matter transferred from one star to another) around white dwarfs, neutron stars and black holes.

HUT COMPONENTS



HUT will make the first observations of a wide variety of astronomical objects in the far ultraviolet region below 1,200 Angstroms (A) and will pioneer the detailed study of stars in the extreme ultraviolet band. Ultraviolet radiation at wavelengths shorter than 912 A is absorbed by hydrogen, the most abundant element in the universe. HUT will allow astronomers, in some instances along unobserved lines of sight, to see beyond this cutoff, called the Lyman limit, because the radiation from the most distant and rapidly receding objects, such as very bright quasars, is shifted toward longer wavelengths.

HUT was designed and built by the Center for Astrophysical Sciences and the Applied Physics Laboratory of The Johns Hopkins University in Baltimore, Md. Its 36-inch mirror is coated with the rare element iridium, a member of the platinum family, capable of reflecting far and extreme ultraviolet light. The mirror, located at the aft end of the telescope, focuses incoming light from a celestial source back to a spectrograph mounted behind the telescope.

A grating within the spectrograph separates the light, like a rainbow, into its component wavelengths. The strengths of those wavelengths tell scientists how much of certain elements are present. The ratio of the spectral lines reveal a source's temperature and density. The shape of the spectrum shows the physical processes occurring in a source.

The spectrograph is equipped with a variety of light-admitting slits or apertures. The science team will use different apertures to accomplish different goals in their observation. The longest slit has a field of view of 2 arc minutes, about 1/15th the apparent diameter of the moon. HUT is fitted with an electronic detector system. Its data recordings are processed by an onboard computer system and relayed to the ground for later analysis.

Johns Hopkins scientists conceived HUT to take ultraviolet astronomy beyond the brief studies previously conducted with rocket-borne telescopes. A typical rocket flight might gather 300 seconds of data on a single object. HUT will collect more than 300,000 seconds of data on nearly 200 objects during the Astro-1 mission, ranging from objects in the solar system to quasars billions of light-years distant.

HUT Vital Statistics

Sponsoring Institution:	The Johns Hopkins University, Baltimore, Md.
Principal Investigator:	Dr. Arthur F. Davidsen
Telescope Optics:	36 in. aperture, f/2 focal ratio, iridium-coated paraboloid mirror
Instrument:	Prime Focus Rowland Circle Spectrograph with microchannel plate intensifier and electronic diode array detector
Field of View of Guide TV:	10 arc minutes
Spectral Resolution:	3.0 A
Wavelength Range:	850 A to 1,850 A (First Order) 425 A to 925 A (Second Order)
Weight:	1,736 lb
Size:	44 inches in diameter 12.4 ft. in length

Wisconsin Ultraviolet Photo-Polarimeter Experiment

Any star, except for our sun, is so distant that it appears as only a point of light and surface details cannot be seen. If the light from objects is polarized, it can tell scientists something about the source's geometry, the physical conditions at the source and the reflecting properties of tiny particles in the interstellar medium along the radiation's path.

The Wisconsin Ultraviolet Photo-Polarimeter Experiment (WUPPE), developed by the Space Astronomy Lab at the University of Wisconsin-Madison, is designed to measure polarization and intensity of ultraviolet radiation from celestial objects. WUPPE is a 20-inch telescope with a 5.5-arc-minute field of view.

WUPPE is fitted with a spectropolarimeter, an instrument that records both the spectrum and the polarization of the ultraviolet light gathered by the telescope. Light will pass through sophisticated filters, akin to Polaroid sunglasses, before reaching the detector. Measurements then will be transmitted electronically to the ground.

Photometry is the measurement of the intensity (brightness) of the light, while polarization is the measurement of the orientation (direction) of the oscillating light wave. Usually waves of light move randomly -- up, down, back, forward and diagonally. When light is polarized, all the waves oscillate in a single plane. Light that is scattered, like sunlight reflecting off water, is often polarized. Astro-1 astronomers expect to learn about ultraviolet light that is scattered by dust strewn among stars and galaxies. They also can learn about the geometry of stars and other objects by studying their polarization. To date, virtually no observations of polarization of astronomical sources in the ultraviolet have been carried out. WUPPE measures the polarization by splitting a beam of radiation into two perpendicular planes of polarization, passing the beams through a spectrometer and focusing the beams on two separate array detectors.

In the ultraviolet spectrum, both photometry and polarization are extremely difficult measurements to achieve with the high degree of precision required for astronomical studies. To develop an instrument that could make these delicate measurements required an unusually innovative and advanced technical effort. Thus, the WUPPE investigation is a pioneering foray with a new technique.

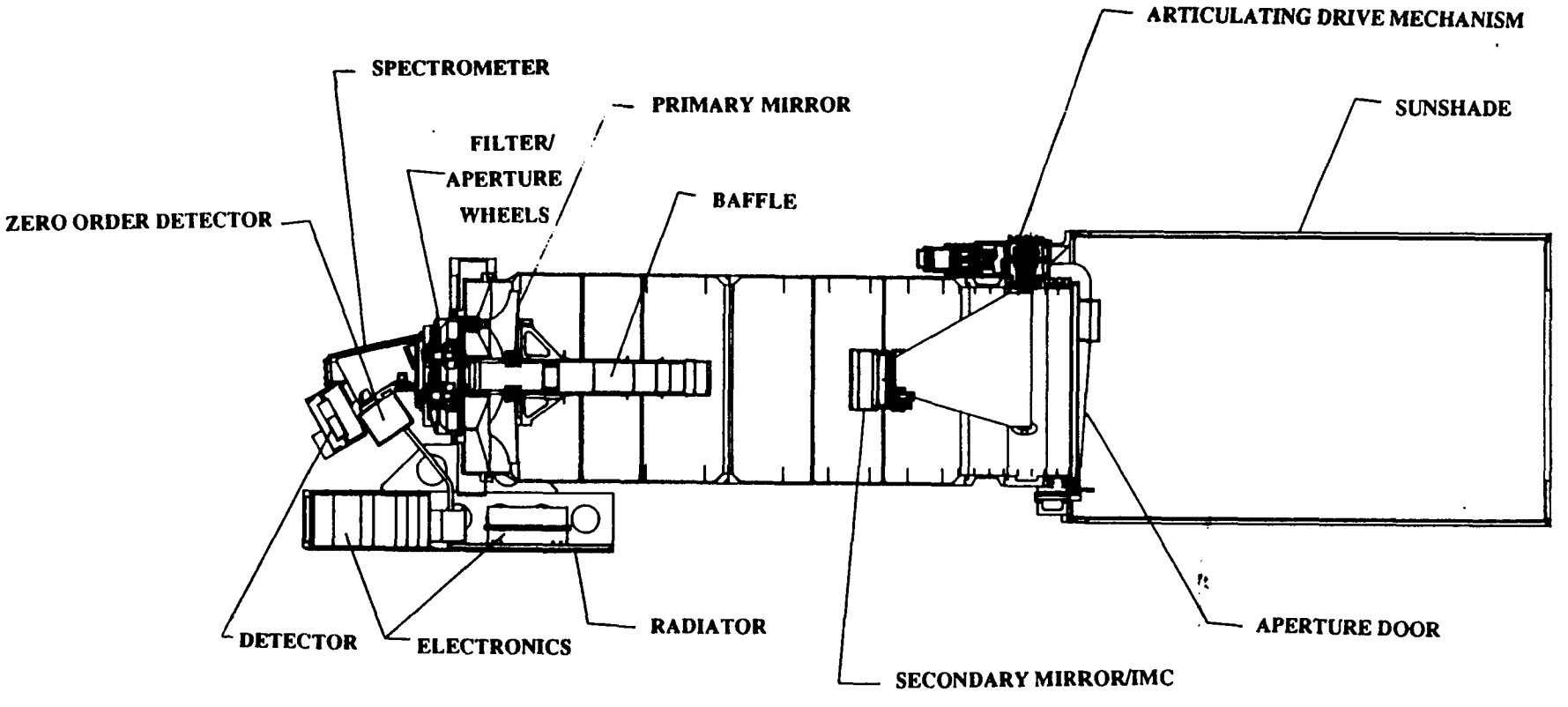
The targets of WUPPE investigations are primarily in the Milky Way galaxy and beyond, for which comparative data exist in other wavelengths. Like the Hopkins Ultraviolet Telescope, WUPPE also makes spectroscopic observations of hot stars, galactic nuclei and quasars. Operating at ultraviolet wavelengths that are mostly longer than those observed by HUT (but with some useful overlap), WUPPE provides chemical composition and physical information on celestial targets that that give off a significant amount of radiation in the 1,400 to 3,200 A range.

WUPPE Vital Statistics

Sponsoring Institution:	University of Wisconsin, Madison
Principal Investigator:	Dr. Arthur D. Code
Telescope Optics:	Cassegrain (two-mirror) system, f/10 focal ratio
Instrument:	Spectropolarimeter with dual electronic diode array detectors
Primary Mirror Size:	20 in. diameter 279 sq.* in. area
Field of View:	3.3 x 4.4 arc minutes
Spectral Resolution:	6 Angstroms
Wavelength Range:	1,400 to 3,200 Angstroms
Magnitude Limit:	16
Weight:	981 lb
Size:	28 inches in diameter 12.4 ft. in length

* This and subsequent changes were made to avoid confusion since the computer will not create exponents for cm2 or the circle over the A for Angstrom.

WUPPE COMPONENTS



The Ultraviolet ImagingTelescope

In the 20 years that astronomical observations have been made from space, no high-resolution ultraviolet photographs of objects other than the sun have been made. Nonetheless, the brief glimpses of the ultraviolet sky have led to important discoveries in spiral galaxies, globular clusters, white dwarf stars and other areas.

Deep, wide-field imaging is a primary means by which fundamentally new phenomena or important examples of known classes of astrophysical objects will be recognized in the ultraviolet. The Ultraviolet Imaging Telescope (UIT), developed at NASA's Goddard Space Flight Center in Greenbelt, Md., is the key instrument for these investigations.

UIT is a powerful combination of telescope, image intensifier and camera. It is a 15.2-inch Ritchey Chretien telescope with two selectable cameras mounted behind the primary mirror. Each camera has a six-position filter wheel, a two-stage magnetically focused image tube and a 70-mm film transport, fiber optically coupled to each image tube. One camera is designed to operate in the 1200 - 1700 Angstrom region and the other in the 1250-3200 Angstrom region.

Unlike data from the other Astro instruments, which will be electronically transmitted to the ground, UIT images will be recorded directly onto a very sensitive astronomical film for later development after Columbia lands. UIT has enough film to make 2,000 exposures. A series of 11 different filters allows specific regions of the ultraviolet spectrum to be isolated for energy-distribution studies. After development, each image frame will be electronically digitized to form 2,048 x 2,048 picture elements, or pixels, then analyzed further with computers.

UIT has a 15-inch diameter mirror with a 40-arc-minute field of view -- about 25 percent wider than the apparent diameter of the full moon. UIT has the largest field of view of any sensitive UV imaging instrument planned for flight in the 1990s. It will photograph nearby galaxies, large clusters of stars and distant clusters of galaxies.

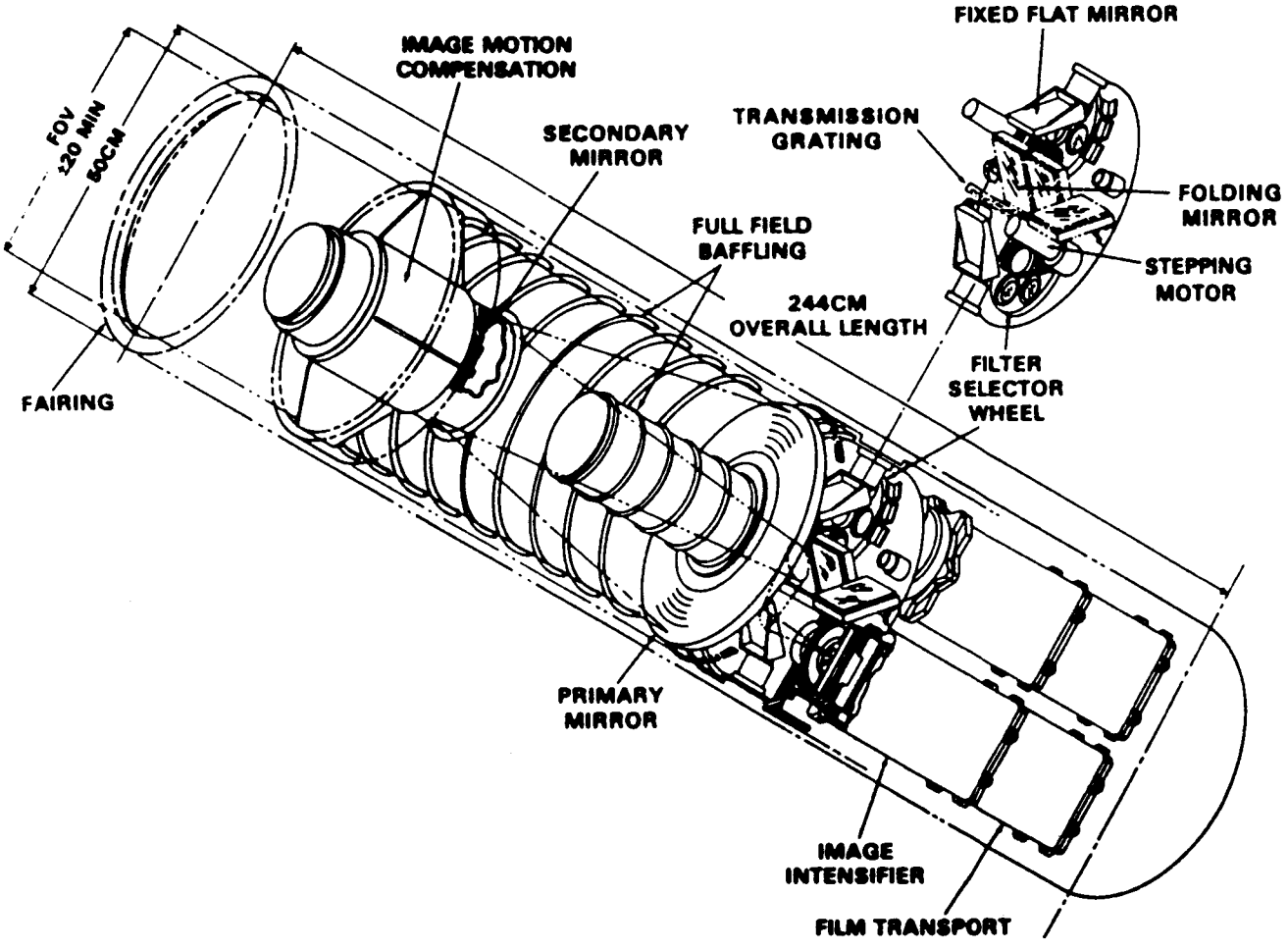
A 30-minute exposure (the length of one orbital night) will record a blue star of 25th magnitude, a star about 100 million times fainter than the faintest star visible to the naked eye on a dark, clear night. Since UIT makes longer exposures than previous instruments, fainter objects will be visible in the images.

The instrument favors the detection of hot objects which emit most of their energy in the ultraviolet. Common examples span the evolutionary history of stars -- massive stars and stars in the final stages of stellar evolution (white dwarfs). Images of numerous relatively cool stars that do not radiate much in the ultraviolet are suppressed, and UV sources stand out clearly.

The UIT's field of view is wide enough to encompass entire galaxies, star clusters and distant clusters of galaxies. This deep survey mode will reveal many new, exciting objects to be studied further by NASA's Hubble Space Telescope. Although the Hubble Space Telescope will have a much higher magnification and record much fainter stars, the UIT will photograph much larger regions all at once. In addition, the UIT will suffer much less interference from visible light, since it is provided with "solar blind" detectors. For certain classes of targets, such as diffuse, ultraviolet-emitting or ultraviolet-scattering nebulae, UIT may be a more sensitive imager.

A wide selection of astronomical objects will be studied in this first deep survey of cosmic phenomena in the ultraviolet. The UIT is expected to target hot stars in globular clusters to help explain how stars evolve. Another experiment may help astronomers learn whether properties and distribution of interstellar dust are the same in all galaxies. High-priority objects are Supernova 1987A and vicinity, star clusters, planetary nebulae and supernova remnants, spiral and "normal" galaxies, the interstellar medium of other galaxies and clusters of galaxies.

UIT COMPONENTS



UIT Vital Statistics

Sponsoring Institution:	NASA Goddard Space Flight Center (GSFC), Greenbelt, Md.
Principal Investigator:	Theodore P. Stecher (NASA GSFC)
Telescope Optics:	Ritchey-Chretien (variation of Cassegrain two-mirror system with correction over wide field of view)
Aperture:	15 in.
Focal Ratio:	f/9
Field of View:	40 arc minutes
Angular Resolution:	2 arc seconds
Wavelength Range:	1,200 A to 3,200 A
Magnitude Limit:	25
Filters:	2 filter wheels, 6 filters each
Detectors:	Two image intensifiers with 70-mm film, 1,000 frames each; IIaO astronomical film
Exposure Time:	Up to 30 minutes
Weight:	1,043 lb
Size:	32 inches in diameter
	12.4 ft. in length

THE BROAD BAND X-RAY TELESCOPE

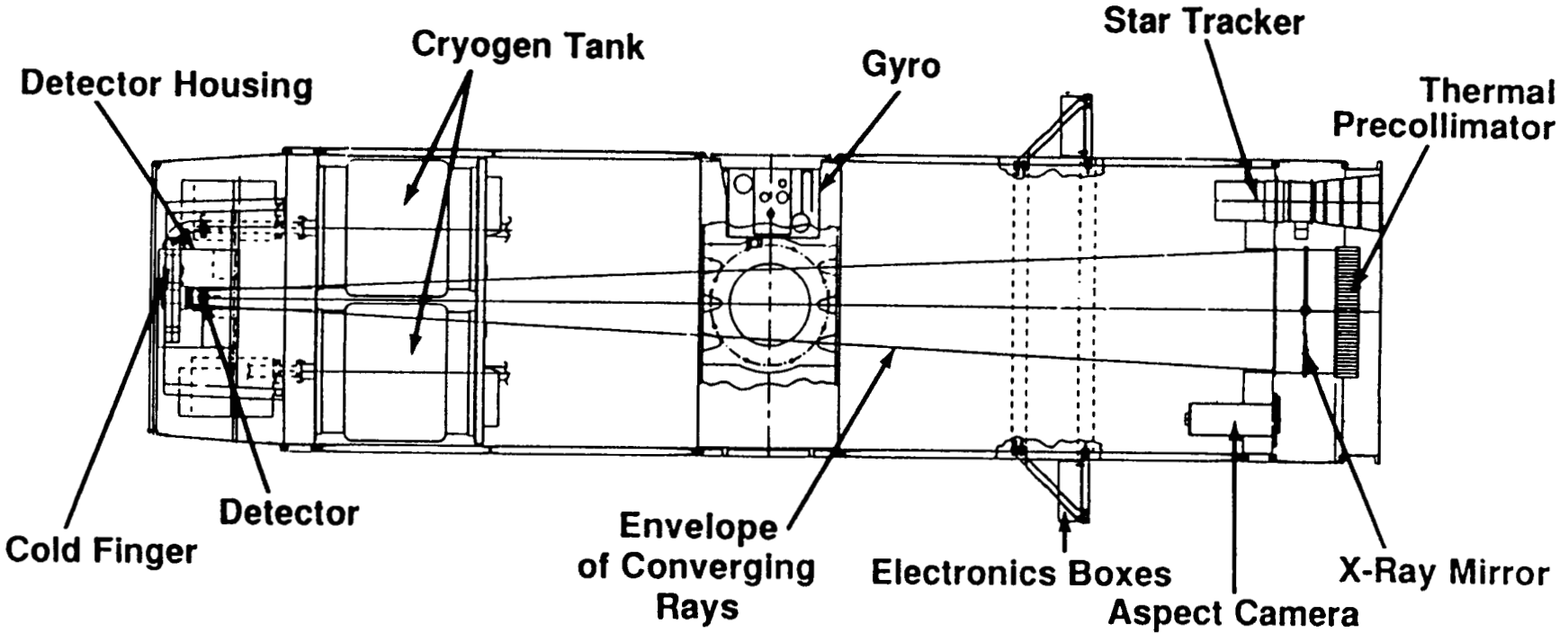
The Broad Band X-Ray Telescope (BBXRT) will provide astronomers with the first high-quality spectra of many of the X-ray sources discovered with the High Energy Astronomy Observatory 2, better known as the Einstein Observatory, launched in the late 1970s. BBXRT, developed at NASA's Goddard Space Flight Center in Greenbelt, Md., uses mirrors and advanced solid-state detectors as spectrometers to measure the energy of individual X-ray photons. These energies produce a spectrum that reveals the chemistry, structure and dynamics of a source.

BBXRT is actually two 8-inch telescopes each with a 17 arc-minute field of view (more than half the angular width of the moon). The two identical telescopes are used to focus X-rays onto solid-state spectrometers which measure photon energy in electron volts in the "soft" X-ray region, from 380 to 12,000 eV. The use of two telescopes doubles the number of photons that are detected and also provides redundancy in case of a failure.

X-ray telescopes are difficult to construct because X-ray photons are so energetic that they penetrate mirrors and are absorbed. A mirror surface reflects X-rays only if it is very smooth and the photons strike it at a very shallow angle. Because such small grazing angles are needed, the reflectors must be very long to intercept many of the incident X-rays. Since even shallower angles are required to detect higher-energy X-rays, telescopes effective at high energies need very large reflecting surfaces.

Traditionally, X-ray telescopes have used massive, finely polished reflectors that were expensive to construct and did not efficiently use the available aperture. The mirror technology developed for BBXRT consists of very thin pieces of gold-coated aluminum foil that require no polishing and can be nested very closely together to reflect a large fraction of the X-rays entering the telescope.

BBXRT COMPONENTS



Because its reflecting surfaces can be made so easily, BBXRT can afford to have mirrors using the very shallow grazing angles necessary to reflect high-energy photons. In fact, BBXRT is one of the first telescopes to observe astronomical targets that emit X-rays above approximately 4,000 electron volts.

The telescope will provide information on the chemistry, temperature and structure of some of the most unusual and interesting objects in the universe. BBXRT can see fainter and more energetic objects than any yet studied. It will look for signs of heavy elements such as iron, oxygen, silicon and calcium. These elements usually are formed in exploding stars and during mysterious events occurring at the core of galaxies and other exotic objects.

BBXRT will be used to study a variety of sources, but a major goal is to increase our understanding of active galactic nuclei and quasars. Many astronomers believe that the two are very similar objects that contain an extremely luminous source at the nucleus of an otherwise relatively normal galaxy. The central source in quasars is so luminous that the host galaxy is difficult to detect. X-rays are expected to be emitted near the central engine of these objects, and astronomers will examine X-ray spectra and their variations to understand the phenomena at the heart of quasars.

Investigators are interested in clusters of galaxies, congregations of tens or thousands of galaxies grouped together within a few million light-years of each other. When viewed in visible light, emissions from individual galaxies are dominant, but X-rays are emitted primarily from hot gas between the galaxies.

In fact, theories and observations indicate that there should be about as much matter in the hot gas as in the galaxies, but all this material has not been seen yet. BBXRT observations will enable scientists to calculate the total mass of a cluster and deduce the amount of "dark" matter.

A star's death, a supernova, heats the region of the galaxy near the explosion so that it glows in X-rays. Scientists believe that heavy elements such as iron are manufactured and dispersed into the interstellar medium by supernovas. The blast or shock wave may produce energetic cosmic ray particles that travel on endless journeys throughout the universe and instigate the formation of new stars. BBXRT detects young supernova remnants (less than 10,000 years old) which are still relatively hot. Elements will be identified, and the shock wave's movement and structure will be examined.

BBXRT was not part of the originally selected ASTRO payload. It was added to the mission after the appearance of Supernova 1987A in February 1987, to obtain vital scientific information about the supernova. In addition, data gathered by BBXRT on other objects will enhance studies that would otherwise be limited to data gathered with the three ultraviolet telescopes.

BBXRT Vital Statistics

Sponsoring Institution:	NASA Goddard Space Flight Center, Greenbelt, Md.
Principal Investigator:	Dr. Peter J. Serlemitsos
Telescope Optics:	Two co-aligned X-ray telescopes with cooled segmented lithium-drifted silicon solid-state detectors in the focal planes
Focal Length:	12.5 ft. each, detection area 0.16 in. diameter pixel
Focal Plane Scale:	0.9 arc minutes per mm
Field of View:	4.5 arc minutes (central element); 17 arc minutes (overall)
Energy Band:	0.3 to 12 keV
Effective Area:	765 cm2 at 1.5 keV, 300 cm2 at 7 keV
Energy Resolution:	0.09 keV at 1 keV, 0.15 keV at 6 keV
Weight:	1,500 lb (680.4 kg)
Size:	40 inches in diameter 166 inches in length

ASTRO CARRIER SYSTEMS

The Astro observatory is made up of three co-aligned ultraviolet telescopes carried by Spacelab and one X-ray telescope mounted on the Two-Axis Pointing System (TAPS) and a special structure.

Each telescope was independently designed, but all work together as elements of a single observatory. The carriers provide stable platforms and pointing systems that allow the ultraviolet and X-ray telescopes to observe the same target. However, having two separate pointing systems gives investigators the flexibility to point the ultraviolet telescopes at one target while the X-ray telescope is aimed at another.

Spacelab

The three ultraviolet telescopes are supported by Spacelab hardware. Spacelab is a set of modular components developed by the European Space Agency and managed by the NASA Marshall Space Flight Center, Hunstville, Ala. For each Spacelab payload, specific standardized parts are combined to create a unique design. Elements are anchored within the cargo bay, transforming it into a short-term laboratory in space.

Spacelab elements used to support the Astro observatory include two pallets, a pressurized igloo to house subsystem equipment and the Instrument Pointing System. The pressurized Spacelab laboratory module will not be used for Astro. Rather, astronauts and payload specialists will operate the payload from the aft flight deck of the orbiter Columbia.

Pallets

The ultraviolet telescopes and the Instrument Pointing System are mounted on two Spacelab pallets -- large, uncovered, unpressurized platforms designed to support scientific instruments that require direct exposure to space.

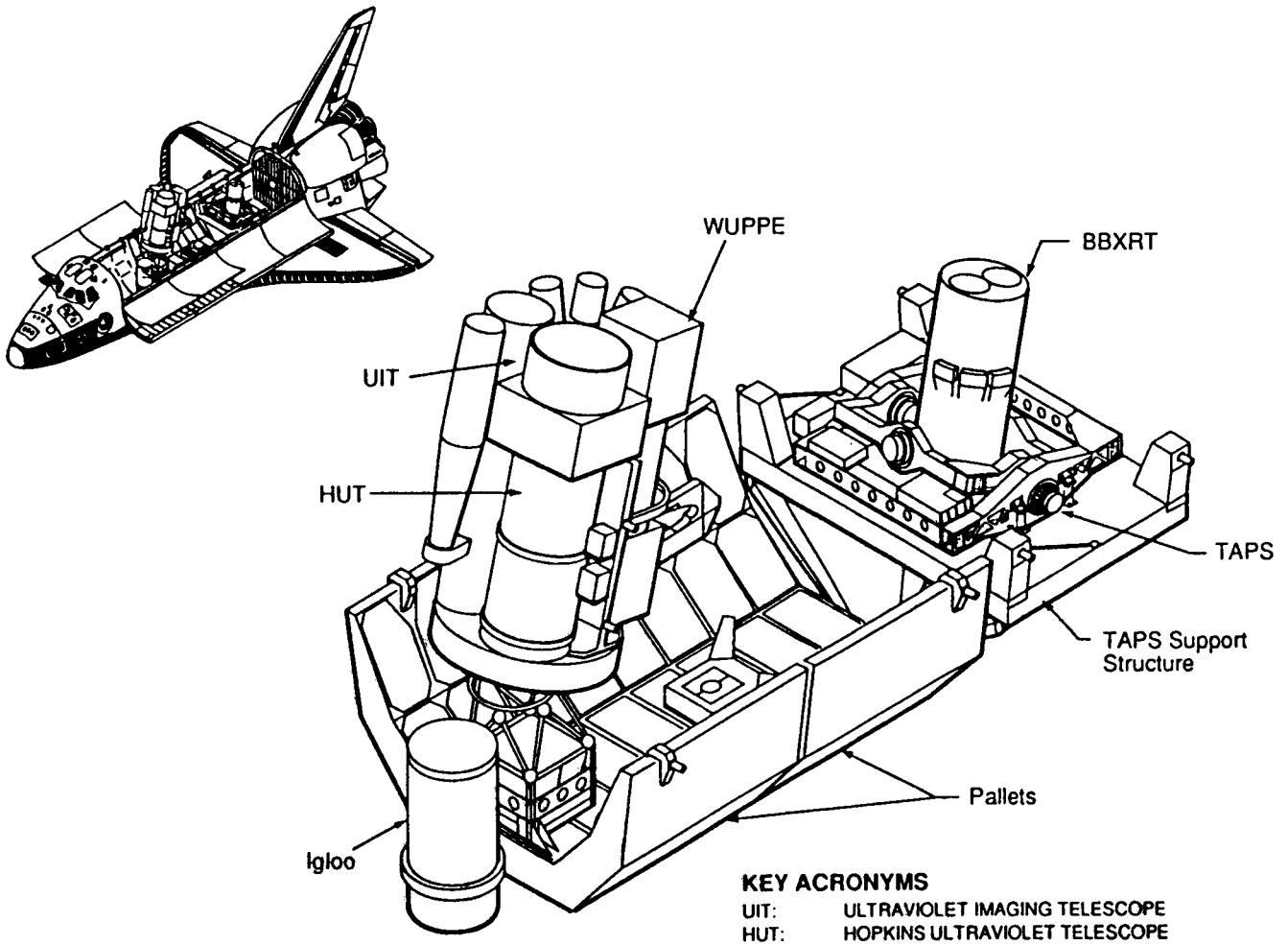
Each individual pallet is 10 feet long and 13 feet wide. The basic pallet structure is made up of five parallel U-shaped frames. Twenty-four inner and 24 outer panels, made of aluminum alloy honeycomb, cover the frame. The inner panels are equipped with threaded inserts so that payload and subsystem equipment can be attached. Twenty-four standard hard points, made of chromium-plated titanium casting, are provided for payloads which exceed acceptable loading of the inner pallets.

Pallets are more than a platform for mounting instrumentation. With an igloo attached, they also can cool equipment, provide electrical power and furnish connections for commanding and acquiring data from experiments. Cable ducts and cable support trays can be bolted to the forward and aft frame of each pallet to support and route electrical cables to and from the experiments and the subsystem equipment mounted on the pallet. The ducts are made of aluminum alloy sheet metal. In addition to basic utilities, some special accommodations are available for pallet-mounted experiments.

For Astro-1, two pallets are connected together to form a single rigid structure called a pallet train. Twelve joints are used to connect the two pallets.

Igloo

Normally Spacelab subsystem equipment is housed in the core segment of the pressurized laboratory module. However, in "pallet only" configurations such as Astro, the subsystems are located in a supply module called the igloo. It provides a pressurized compartment in which Spacelab subsystem equipment can be mounted in a dry-air environment at normal Earth atmospheric pressure, as required by their design. The subsystems provide such services as cooling, electrical power and connections for commanding and acquiring data from the instruments.



KEY ACRONYMS

UIT:	ULTRAVIOLET IMAGING TELESCOPE
HUT:	HOPKINS ULTRAVIOLET TELESCOPE
WUPPE:	WISCONSIN UV PHOTO-POLARIMETER EXPERIMENT
BBXRT:	BROAD BAND X RAY TELESCOPE
TAPS:	TWO-AXIS POINTING SYSTEM

The igloo is attached vertically to the forward end frame of the first pallet. Its outer dimensions are approximately 7.9 feet in height and 3.6 feet in diameter. The igloo is a closed cylindrical shell made of aluminum alloy and covered with multi-layer insulation. A removable cover allows full access to the interior.

The igloo consists of two parts. The primary structure -- an exterior cannister -- is a cylindrical, locally stiffened shell made of forged aluminum alloy rings and closed at one end. The other end has a mounting flange for the cover. A seal is inserted when the two structures are joined together mechanically to form a pressure-tight assembly.

There are external fittings on the cannister for fastening it to the pallet, handling and transportation on the ground, and thermal control insulation. Two feed-through plates accommodate utility lines and a pressure relief valve. Facilities on the inside of the cannister are provided for mounting subsystem equipment and the interior igloo structure. The cover is also a cylindrical shell, made of welded aluminum alloy and closed at one end. The igloo has about 77.7 cubic feet of interior space for subsystems.

Subsystem equipment is mounted on an interior or secondary structure which also acts as a guide for the removal or replacement of the cover. The secondary structure is hinge-fastened to the primary structure, allowing access to the bottom of the secondary structure and to equipment mounted within the primary structure.

Instrument Pointing System

Telescopes such as those aboard Astro-1 must be pointed with very high accuracy and stability at the objects which they are to view. The Spacelab Instrument Pointing System provides precision pointing for a wide range of payloads, including large single instruments or clusters of instruments. The pointing mechanism can accommodate instruments weighing up to 15,432 pounds and can point them to within 2 arc seconds and hold them on target to within 1.2 arc seconds. The combined weight of the ultraviolet telescopes and the structure which holds them together is 9,131 pounds.

The Instrument Pointing System consists of a three-axis gimbal system mounted on a gimbal support structure connected to the pallet at one end and the aft end of the payload at the other, a payload clamping system for support of the mounted experiment during launch and landing and a control system based on the inertial reference of a three-axis gyro package and operated by a gimbal-mounted microcomputer.

Three bearing-drive units on the gimbal system allow the payload to be pointed on three axes: elevation (back and forth), cross-elevation (side to side) and azimuth (roll), allowing it to point in a 22-degree circle around a its straight-up position. The pointing system may be maneuvered at a rate of up to one degree per second, which is five times as fast as the Shuttle orbiter's maneuvering rate. The operating modes of the different scientific investigations vary considerably. Some require manual control capability, others slow scan mapping, still others high angular rates and accelerations. Performance in all these modes requires flexibility achieved with computer software.

The Instrument Pointing System is controlled through the Spacelab subsystem computer and a data-display unit and keyboard. It can be operated either automatically or by the Spacelab crew from the module (when used) and also from the payload station in the orbiter aft flight deck.

In addition to the drive units, Instrument Pointing System structural hardware includes a payload/gimbal separation mechanism, replaceable extension column, emergency jettisoning device, support structure and rails and a thermal control system. The gimbal structure itself is minimal, consisting only of a yoke and inner and outer gimbals to which the payload is attached by the payload-mounted integration ring.

An optical sensor package is used for attitude correction and also for configuring the instrument for solar, stellar or Earth viewing. The Astro-1 mission marks the first time the Instrument Pointing System has been used for stellar astronomy. Three star trackers locate guide stars. The boresite tracker is in the middle, and two other trackers are angled 12 degrees from each side of the boresite. By keeping stars of known locations centered in each tracker, a stable position can be maintained.

The three ultraviolet telescopes are mounted and precisely co-aligned on a common structure, called the cruciform, that is attached to the pointing system.

Image Motion Compensation System

An image motion compensation system was developed by the Marshall Space Flight Center to provide additional pointing stability for two of the ultraviolet instruments.

When the Shuttle thrusters fire to control orbiter attitude, there is a noticeable disturbance of the pointing system. The telescopes are also affected by crew motion in the orbiter. A gyro stabilizer senses the motion of the cruciform which could disrupt UIT and WUPPE pointing stability. It sends information to the image motion compensation electronics system where pointing commands are computed and sent to the telescopes' secondary mirrors which make automatic adjustments to improve stability to less than 1 arc second.

The Astro-1's star tracker, designed by the NASA Jet Propulsion Laboratory, Pasadena, Calif., fixes on bright stars with well-known and sends this information to the electronics system which corrects errors caused by gyro drift and sends new commands to the telescopes' mirrors. The mirrors automatically adjust to keep pointed at the target.

Broad Band X-ray Telescope and the Two-Axis Pointing System (TAPS)

Developed at the NASA Goddard Space Flight Center, these pointing systems were designed to be flown together on multiple missions. This payload will be anchored in a support structure placed just behind the ultraviolet telescopes in the Shuttle payload bay. BBXRT is attached directly to the TAPS inner gimbal frame.

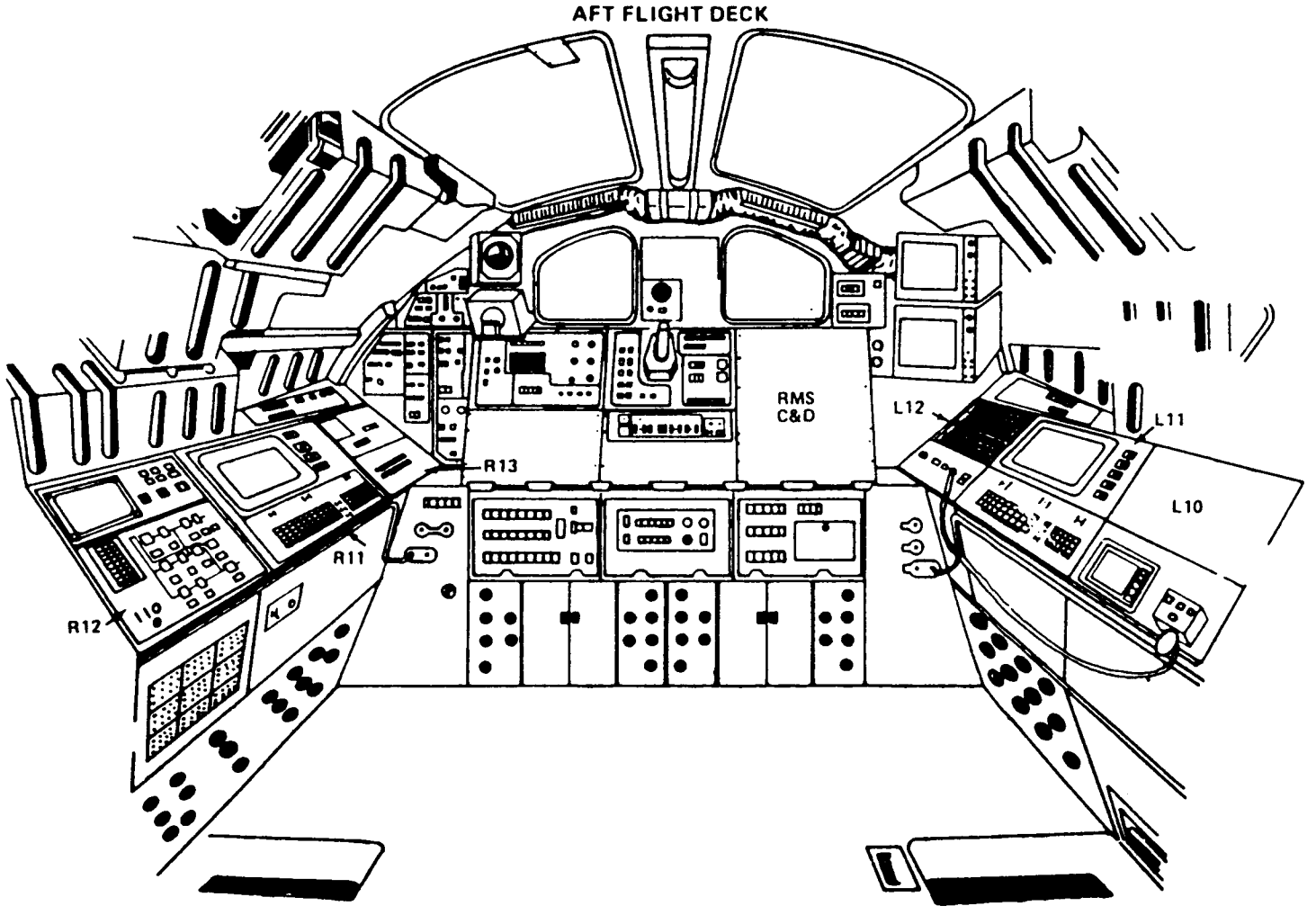
The TAPS will move BBXRT in a forward/aft direction (pitch) relative to the cargo bay or from side to side (roll) relative to the cargo bay. A star tracker uses bright stars as a reference to position the TAPS for an observation, and gyros keep the TAPS on a target. As the gyros drift, the star tracker periodically recalculates and resets the TAPS position.

ASTRO OPERATIONS

Operation of the Astro-1 telescopes will be a cooperative effort between the science crew in orbit and their colleagues in a control facility at the Marshall Space Flight Center and a support control center at Goddard Space Flight Center. Though the crew and the instrument science teams will be separated by many miles, they will interact with one another to evaluate observations and solve problems in much the same way as they would when working side by side.

On-Orbit Science Crew Activities

The Astro science crew will operate the ultraviolet telescopes and Instrument Pointing System from the Shuttle orbiter's aft flight deck, located to the rear of the cockpit. Windows overlooking the cargo bay allow the payload specialist and mission specialist to keep an eye on the instruments as they command them into precise position. The aft flight deck is equipped with two Spacelab keyboard and display units, one for controlling the pointing system and the other for operating the scientific instruments. To aid in target identification, this work


AFT FLIGHT DECK
RMS
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L12
L11
L10
R13
R11
R12
R10

area also includes two closed-circuit television monitors. With the monitors, crew members will be able to see the star fields being viewed by HUT and WUPPE and monitor the data being transmitted from the instruments.

The Astro-1 crew will work around the clock to allow the maximum number of observations to be made during their mission. The STS-35 commander will have a flexible schedule, while two teams of crew members will work in 12-hour shifts. Each team consists of the pilot or flight mission specialist, a science mission specialist and a payload specialist. The crew and the ground controllers will follow an observation schedule detailed in a carefully planned timeline.

In a typical Astro-1 ultraviolet observation, the flight crew member on duty maneuvers the Shuttle to point the cargo bay in the general direction of the astronomical object to be observed. The mission specialist commands the pointing system to aim the telescopes toward the target. He also locks on to guide stars to help the pointing system remain stable despite orbiter thruster firings. The payload specialist sets up each instrument for the upcoming observation, identifies the celestial target on the guide television and provides any necessary pointing corrections for placing the object precisely in the telescope's field of view. He then starts the instrument observation sequences and monitors the data being recorded. Because the many observations planned create a heavy workload, the payload and mission specialists work together to perform these complicated operations and evaluate the quality of observations. Each observation will take between 10 minutes to a little over an hour.

The X-ray telescope requires little attention from the crew. A crew member will turn on the BBXRT and the TAPS at the beginning of operations and then turn them off when the operations conclude. The telescope is controlled from the ground. After the telescope is activated, researchers at Goddard can "talk" to the telescope via computer. Before science operations begin, stored commands are loaded into the BBXRT computer system. Then, when the astronauts position the Shuttle in the general direction of the source, the TAPS automatically points the BBXRT at the object. Since the Shuttle can be oriented in only one direction at a time, X-ray observations must be coordinated carefully with ultraviolet observations.

GROUND CONTROL

Astro-1 science operations will be directed from a new Spacelab Mission Operations Control facility at the Marshall Space Flight Center. BBXRT will be controlled by commands from a supporting payload operations control facility at Goddard.

Spacelab Mission Operations Control

Beginning with the Astro-1 flight, all Spacelab science activities will be controlled from Marshall's Spacelab Mission Operations Control Center. It will replace the payload operations control center at the Johnson Space Center from which previous Spacelab missions have been operated. The Spacelab Mission Operations Control team is under the overall direction of the mission manager.

The Spacelab Mission Operations Control team will support the science crew in much the same way that Houston Mission Control supports the flight crew. Teams of controllers and researchers at the Marshall facility will direct all NASA science operations, send commands directly to the spacecraft, receive and analyze data from experiments aboard the vehicle, adjust mission schedules to take advantage of unexpected science opportunities or unexpected results, and work with crew members to resolve problems with their experiments.

An air/ground communications channel, in addition to the one used by the Mission Control Center in Houston, will be dedicated to communications between the Alabama control facility and the science crew aboard the Space Shuttle. "Huntsville" will be the call sign from space that astronauts will use to address their control team at the Marshall facility.

The Spacelab Mission Operations Control facility is located on two floors of Building 4663 at the Marshall Space Flight Center. Most of the activity occurs in two work areas: the payload control area on the upper floor from which the overall payload is monitored and controlled; and the science operations area on the ground level, where scientists for the individual telescopes monitor their instruments and direct observations.

The payload control area is the hub of payload operations. Communication with the crew, on-orbit and ground computer systems monitoring, science activities, and even television camera operations are marshalled from work stations in the control room. Console operators in the area are referred to as the payload operations control center (POCC) cadre. The cadre is made up of three teams under the leadership of the payload operations director.

The operations control team is responsible for real-time payload control. They make sure that the pre-planned observation schedule is being followed and send commands to the instruments and instructions to the crew. Designated team members stay in voice contact with the the on-board science crew via an air-to-ground communications loop.

The data management team ensures that the science data needed from the payload is scheduled and received properly. The responsibilities range from telling the on-board computer when to send down the information it has been storing to scheduling TV transmissions from orbit.

The payload activities planning team is in charge of replanning the payload crew activity schedule when anything from unexpected science opportunities to equipment problems requires a change. After a science operations planning group makes rescheduling decisions for upcoming shifts, the planning team determines the many adjustments that will allow those changes to be accomplished.

The POCC cadre also includes the mission scientist, who leads the science operations planning group and acts as a liaison between the cadre and the science investigator teams; the alternate payload specialist, a backup crew member who helps with air-to-ground communications and assists the mission scientist; and a public affairs commentator.

The science operations area on the ground floor of the Spacelab Mission Operations Control facility is staffed by teams of scientists and engineers who developed the Astro-1 telescopes. The principal investigators and support groups for the Hopkins Ultraviolet Telescope, the Ultraviolet Imaging Telescope and the Wisconsin Photo-Polariameter Experiment, along with the Broad Band X-ray telescope representatives and a team monitoring the Marshall Space Flight Center's Image Motion Compensation System share a large room in the science operations area.

The teams monitor the data flowing back from each instrument, evaluate the instruments' performance, and assess and analyze the science information revealed by the data. It is possible for the principal investigator to talk directly with the crew member operating his instrument if circumstances demand personal interaction.

Engineers on the science teams provide inputs on instrument performance and if necessary recommend alternate methods to maintain optimal performance. Scientists in each group evaluate the quality of data given the scientific objectives. They also may do preliminary analysis of their data, though a complete study may take months or even years.

Space astronomy is a fluid process because observations sometimes produce unexpected results that demand more study than originally planned during the mission. In addition, hardware contingencies may demand that some activities be rescheduled. Any changes in the plan will affect the observations of all four science teams. Therefore, representatives from each team participate in the twice-daily, science-operations planning group meetings. The science objectives and viewpoints of the various teams are weighed; then the group agrees on changes to the original activity plan.

BBXRT Payload Operations Control Center

A special team located at a remote payload operations control center at the Goddard Space Flight Center will operate the Broad Band X-Ray Telescope and its Two-Axis Pointing System. However, some members of the BBXRT team will be stationed at the Marshall control center to participate in science planning, and all commands issued to the payload will be coordinated with the mission management team at Marshall. The two payload operations control centers will be linked via voice communication so that teams at both places can confer.

ASTRO-1 HISTORY

In February 1978, NASA issued an announcement of opportunity for instruments that could travel aboard the Space Shuttle and utilize the unique capabilities of Spacelab. Three telescopes -- HUT, UIT, and WUPPE -- evolved as a payload manifested as OSS-3 through 7, and these missions were assigned to the Goddard Space Flight Center. Because the Instrument Pointing System and other Spacelab facilities were needed for OSS-3, management was moved in 1982 to the Marshall Space Flight Center. The payload was renamed Astro.

The Wide Field Camera was added to the payload in 1984 to make detailed studies of Comet Halley, which was due to move through the inner solar system in the spring of 1986.

The instruments were constructed, and the observatory had completed Spacelab integration and testing by January 1986. Astro-1, consisting of HUT, UIT, WUPPE and the Wide Field Camera, was ready for orbiter installation when the Challenger accident occurred.

After the accident, the instruments were removed from Spacelab and stored. Periodic checks were made during storage. However, because of the the long interval, the decision was made to examine and recertify all of the Astro instruments. As a part of this process, questions arose in the summer of 1987 about the quality certifications of the bolts used in the Astro-1 hardware. Support structures and instrument and electronics attachments were inspected for possible faulty bolts. A total of 298 bolts eventually were replaced.

HUT was kept at Kennedy Space Center, but its spectrograph was returned to The Johns Hopkins University in October 1988. Although protected from air and moisture by gaseous nitrogen, HUT's extremely sensitive ultraviolet detector had degraded with time. The detector was replaced but failed to pass an acceptance review, and a third detector was installed in January 1989. An aging television camera was replaced in May 1989.

WUPPE's precise instruments also required recalibration after their storage period. Rather than ship the large, sensitive telescope back to the University of Wisconsin where it was developed, astronomers there built a portable vertical calibration facility and delivered it to the Kennedy Space Center. Calibration was completed in April 1989.

WUPPE's power supplies for the spectrometer and for the zero order detector were returned to the University of Wisconsin, where they were modified to reduce output noise.

UIT also stayed at Kennedy, where the power supply for its image intensifier was replaced in August 1989.

Because Comet Halley was no longer in position for detailed observation, the Wide Field Camera was removed from the payload in the spring of 1987. In March of 1988, BBXRT was added to the Astro-1 payload. Originally proposed in response to the 1978 announcement of opportunity, BBXRT had been developed as one of three X-ray instruments in a payload designated OSS-2. This was renamed the Shuttle High-Energy Astrophysics Laboratory and proposed for flight in 1992. However, when Supernova 1987A occurred, BBXRT was completed ahead of schedule and added to the Astro-1 payload. The addition would allow study of the supernova and other objects in X-ray as well as ultraviolet wavelengths.

The completed payload was tested at 6-month intervals. Level IV testing, in which instruments and command software are operated apart from Spacelab pallets, was completed in August 1989. The three ultraviolet telescopes, the Instrument Pointing System and the igloo were integrated with the Spacelab pallets for Level III testing, which concluded in December 1989. The pallet-mounted ultraviolet telescopes and pointing system, as well as the BBXRT and its Two-Axis Pointing System, were moved to the Cargo Integration Test Equipment stand where testing was completed at the end of February 1990.

Astro-1 was installed in Columbia's payload bay March 20, 1990. Final integrated testing in the Orbiter Processing Facility between the orbiter, payload, mission centers and satellite relays was completed March 26-28. Payload pad activities included installation of Ultraviolet Imaging Telescope (UIT) film, removal of telescope covers, final pallet cleaning and BBXRT argon servicing.

SHUTTLE AMATEUR RADIO EXPERIMENT (SAREX)

Conducting shortwave radio transmissions between ground-based amateur radio operators and a Shuttle-based amateur radio operator is the basis for the Shuttle Amateur Radio Experiment (SAREX).

SAREX communicates with amateur stations in line-of-sight of the orbiter in one of four transmission modes: voice, slow scan television (SSTV), data or (uplink only) fast scan television (FSTV).

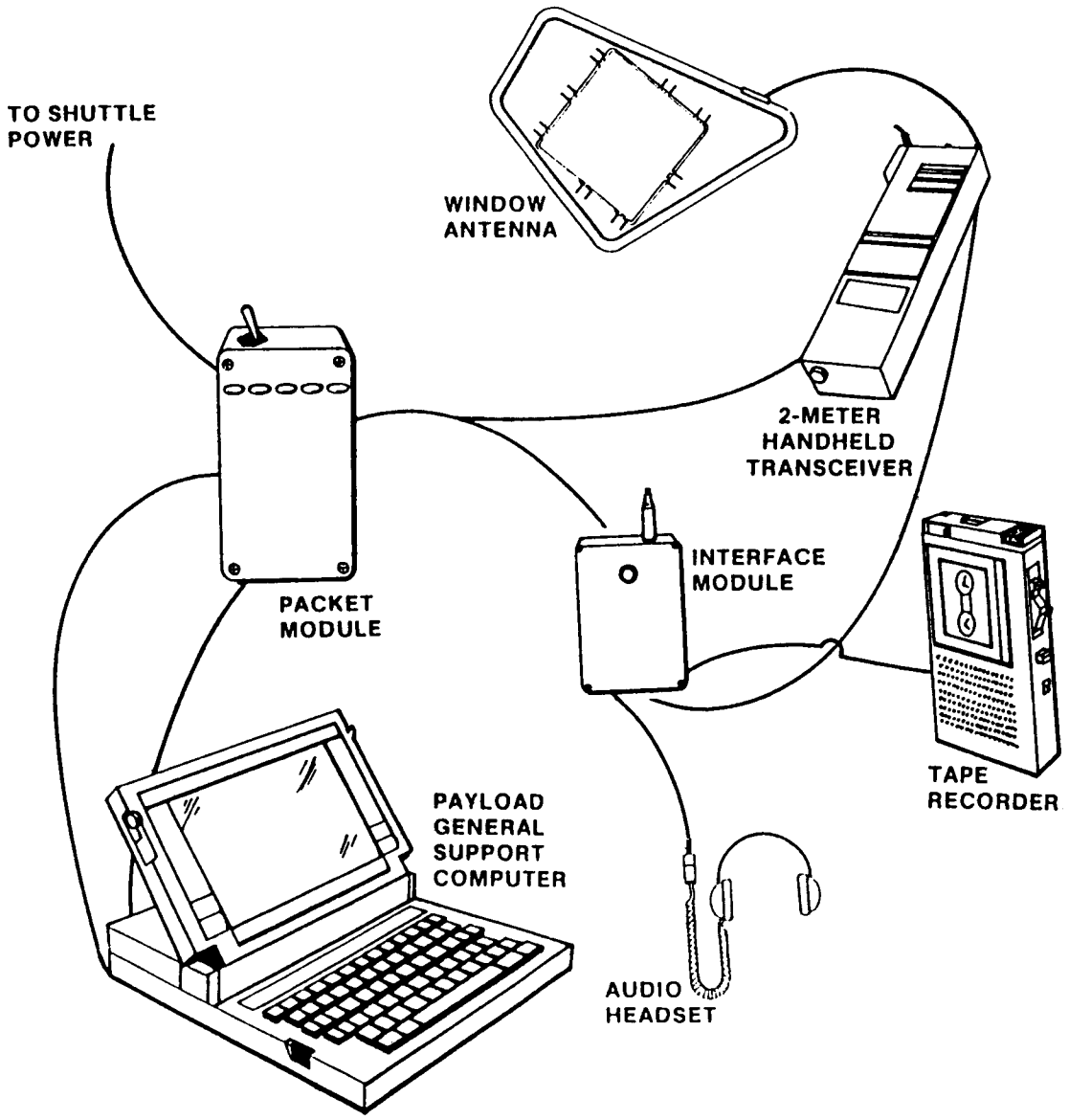
The voice mode is operated in the attended mode while SSTV, data or FSTV can be operated in either attended or unattended modes.

During the mission, SAREX will be operated by Payload Specialist Ron Parise, a licensed operator (WA4SIR), during periods when he is not scheduled for orbiter or other payload activities. At least four transmissions will be made to test each transmission mode.

The primary pair of frequencies intended for use during the mission is 145.55 MHz as the downlink from Columbia, with 144.95 MHz as the uplink. A spacing of 600 KHz was deliberately chosen for this primary pair to accommodate those whose split frequency capability is limited to the customary repeater offset.

SAREX crew-tended operating times will be dictated by the time of launch. As a secondary payload, SAREX will be operated by Parise during his pre- and post-sleep activities each day. This means that wherever the Shuttle is above Earth during those operating windows, amateur stations can communicate with Columbia. Currently, those windows provide coverage for Australia, Japan, South America and South Africa.

SAREX OPERATIONAL CONFIGURATION



The continental United States has little or no coverage except through a network of ground stations in other parts of the world in conjunction with relay links back to the United States.

Another part of the SAREX is the "robot," providing an automated operation which can proceed with little human intervention. The robot will generally be activated during one of the crew-tended windows and deactivated during the next one. This gives approximately 12 hours on and 12 hours off for the robot, with the operational period chosen to cover all of the U.S. passes.

SAREX has previously flown on missions STS-9 and STS-51F in different configurations, including the following hardware: a low-power hand-held FM transceiver, a spare battery set, an interface (I/F) module, a headset assembly, an equipment assembly cabinet, a television camera and monitor, a payload general support computer (PGSC) and an antenna which will be mounted in a forward flight window with a fast scan television (FSTV) module added to the assembly.

Antenna location does not affect communications and therefore does not require a specific orbiter attitude for operations. The equipment is stowed in one middeck locker.

SAREX is a joint effort of NASA and the American Radio Relay League (ARRL)/Amateur Radio Satellite Corporation (AMSAT)

STS-35 COLUMBIA SAREX FREQUENCIES

	Shuttle Transmit Frequency	Accompanying Shuttle Receive Frequencies
Group 1	145.55 MHz	144.95 MHz
	145.55	144.91
	145.55	144.97
Group 2	145.51	144.91
	145.51	144.93
	145.51	144.99
Group 3	145.59	144.99
	145.59	144.95
Group 4	145.55	144.95
	145.55	144.70
	145.55	144.75
	145.55	144.80
	145.55	144.85

Note: The 145.55/144.95 combination is in both Groups 1 and 4 because alternate uplink frequencies from Group 1 would be used over North and South America while those from Group 4 would be used generally in other parts of the world.

"SPACE CLASSROOM, ASSIGNMENT: THE STARS"

"Space Classroom" is a new NASA educational effort designed to involve students and teachers in the excitement of Space Shuttle science missions. This new program joins more than 160 other educational programs being conducted by NASA that use the agency's missions and unique facilities to help educators prepare students to meet the nation's growing need for a globally competitive work force of skilled scientists and engineers.

The first Space Classroom project, called Assignment: The Stars, will capitalize on the May 1990 flight of Astro-1, a Space Shuttle astronomy mission. It is designed to spark the interest of middle school students, encouraging them to pursue studies in mathematics, science and technology. It will offer educators an alternative approach to teaching their students about the electromagnetic spectrum -- a science concept that is required instruction in many classrooms in the United States.

Space Classroom, Assignment: The Stars, involves several educational elements: a lesson on the electromagnetic spectrum to be taught live by the Astro-1 crew from the cabin of the Space Shuttle Columbia during the flight; a supporting lesson to be taught from the Astro-1 control center in Huntsville, Ala.; an Astro-1 teachers guide; an Astro-1 slide presentation; a NASA educational satellite video conference next fall; and post-flight video products suitable for classroom use.

The major component of Assignment: The Stars will be a lesson taught by members of the Astro-1 science crew from the Space Shuttle as they orbit the Earth during the mission. This 15-20 minute presentation will focus on the electromagnetic spectrum and its relationship to the high-energy astronomy mission.

The crew presentation will be followed by demonstrations and discussions of the concepts introduced by the crew from a classroom in the Astro-1 control center at Marshall Space Flight Center.

The lesson will conclude with an opportunity for some students participating in the lesson from Marshall and students at Goddard Space Flight Center, Greenbelt, Md., to ask questions of the crew in orbit. Students at both centers will participate in additional workshops, tours and laboratory sessions.

The lesson by the crew, the follow-up lesson from the Astro-1 control center and the question-answer session will be carried live on NASA Select TV, Satcom satellite F2R, transponder 13, 3960 megahertz, 72 degrees West longitude. NASA Select will carry continuous programming of all mission events as well. The lesson is tentatively scheduled for the fifth day of the mission.

Beginning about 1 week before launch, Astro-1 Update, a recorded bulletin on the status of the Astro-1 mission and Space Classroom, will be available by dialing 205/544-8504.

In the fall of 1990, tapes of the lesson will available for a small fee from NASA CORE, Lorain County Joint Vocational School, 15181 Route 58 South, Oberlin, Ohio, 44074 (phone: 216/ 774-1051).

ORBITER EXPERIMENTS PROGRAM

The advent of operations of the Space Shuttle orbiter provided an opportunity for researchers to perform flight experiments on a full-scale, lifting vehicle during atmospheric entry. In 1976, to take advantage of this opportunity, NASA's Office of Aeronautics, Exploration and Technology instituted the Orbiter Experiments (OEX) Program.

Since the program's inception, 13 experiments have been developed for flight. Principal investigators for these experiments represent NASA's Langley and Ames Research Centers, Johnson Space Center and Goddard Space Flight Center.

Six OEX experiments will be flown on STS-35. Included among this group will be five experiments which were intended to operate together as a complementary set of entry research instrumentation. This flight marks the first time since the September 1988 return-to-flight that the Langley experiments will fly as a complementary set.

Shuttle Entry Air Data System (SEADS)

The SEADS nosecap on the orbiter Columbia contains 14 penetration assemblies, each containing a small hole through which the surface air pressure is sensed. Measurement of the pressure levels and distribution allows post-flight determination of vehicle attitude and atmospheric density during entry. SEADS, which has flown on three previous flights of Columbia, operates in an altitude range of 300,000 feet to landing. Paul M. Siemers III, Langley, is the principal investigator.

Shuttle Upper Atmosphere Mass Spectrometer (SUMS)

The SUMS experiment complements SEADS by enabling measurement of atmospheric density above 300,000 feet. SUMS samples air through a small hole on the lower surface of the vehicle just aft of the nosecap. It utilizes a mass spectrometer operating as a pressure sensing device to measure atmospheric density in the high altitude, rarefied flow regime where the pressure is too low for the use of ordinary pressure sensors. The mass spectrometer incorporated in the SUMS experiment was spare equipment originally developed for the Viking Mars Lander. This is the first opportunity for SUMS to fly since STS-61C in January 1986. Robert C. Blanchard and Roy J. Duckett, Langley, are co-principal investigators.

Both SEADS and SUMS provide entry atmospheric environmental (density) information. These data, when combined with vehicle motion data, allow determination of in-flight aerodynamic performance characteristics of the orbiter.

Aerodynamic Coefficient Identification Package (ACIP)

The ACIP instrumentation includes triaxial sets of linear accelerometers, angular accelerometers and angular rate gyros, which sense the orbiter's motions during flight. ACIP provides the vehicle motion data which is used in conjunction with the SEADS environmental information for determination of aerodynamic characteristics below about 300,000 feet altitude.

The ACIP has flown on all flights of Challenger and Columbia. David B. Kanipe, Johnson Space Center, is the ACIP principal investigator.

High Resolution Accelerometer Package (HiRAP)

This instrument is a triaxial, orthogonal set of highly sensitive accelerometers which sense vehicle motions during the high altitude portion (above 300,000 feet) of entry. This instrument provides the companion vehicle motion data to be used with the SUMS results. HiRAP has been flown on 11 previous missions of the orbiters Columbia and Challenger. Robert C. Blanchard, Langley, is the HiRAP principal investigator.

Shuttle Infrared Leeside Temperature Sensing (SILTS)

This experiment uses a scanning infrared radiometer located atop the vertical tail to collect infrared images of the orbiter's leeside (upper) surfaces during entry, for the purpose of measuring the temperature distribution and thereby the aerodynamic heating environment. On two previous missions, the experiment obtained images of the left wing. For STS-35, the experiment has been reconfigured to obtain images of the upper fuselage.

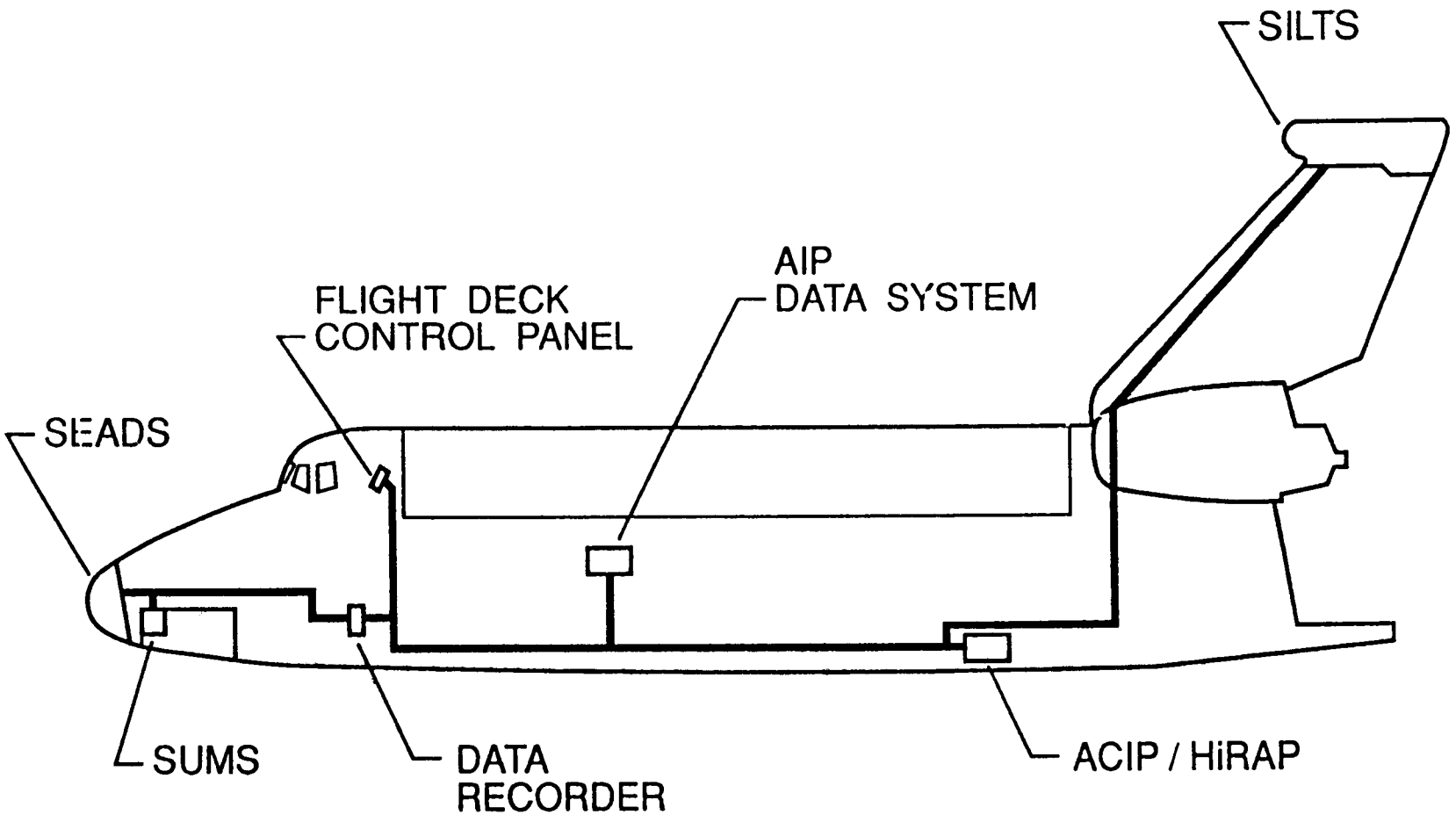
SILTS has flown on three Columbia flights. David A. Throckmorton and E. Vincent Zoby, Langley, are co-principal investigators.

Aerothermal Instrumentation Package (AIP)

The AIP comprises some 125 measurements of aerodynamic surface temperature and pressure at discrete locations on the upper surface of the orbiter's left wing and fuselage, and vertical tail. These sensors originally were part of the development flight instrumentation system which flew aboard Columbia during its Orbital Flight Test missions (STS-1 through 4). They have been reactivated through the use of an AIP-unique data handling system. Among other applications, the AIP data provide "ground-truth" information for the SILTS experiment.

The AIP has flown on two previous Columbia flights. David A. Throckmorton, Langley, is principal investigator.

ORBITER EXPERIMENTS PROGRAM CONFIGURATION FOR STS-35



STS-35 CREW BIOGRAPHIES

Vance D. Brand, 58, will serve as Commander. Selected as an astronaut in 1966, he considers Longmont, Colo., to be his hometown. STS-35 will be Brand's fourth space flight.

Brand was Apollo Command Module Pilot on the Apollo-Soyuz Test Project (ASTP) mission, launched on July 15, 1975. This flight resulted in the historic meeting in space between American astronauts and Soviet cosmonauts. The three-member U.S.crew spent 9 days in Earth orbit.

Brand's second flight was as Commander of STS-5 in November 1982, the first fully operational flight of the Shuttle Transportation System and first mission with a four person crew. Brand next commanded the 10th Space Shuttle mission aboard Challenger. STS-41B with its crew of five was launched Feb. 3, 1984.

Prior to joining NASA, Brand was a commissioned officer and naval aviator with the U.S. Marine Corps from 1953 to 1957. Following release from active duty, he continued in Marine Corps Reserve and Air National Guard jet fighter squadrons until 1964. Brand was employed as a civilian by the Lockheed Aircraft Corporation from 1960 to 1966. He was an experimental test pilot on Canadian and German F-104 programs and has logged 8,777 flying hours, which includes 7,312 hours in jets, 391 hours in helicopters, 531 hours in spacecraft and checkout in more than 30 types of military aircraft.

Guy S. Gardner, 42, Col. USAF, will serve as Pilot. Selected as an astronaut in 1980, he considers Alexandria, Va., to be his hometown. STS-35 will be his second Shuttle flight.

Gardner was Pilot for STS-27, a 4-day flight of Atlantis launched Dec. 2, 1988. The mission carried a Department of Defense payload. The crew completed their mission with a lakebed landing at Edwards on Dec. 6.

Gardner graduated from George Washington High School in Alexandria in 1965. He received a bachelor of science degree in engineering sciences, astronautics and mathematics from the USAF Academy in 1969 and a master of science degree in astronautics from Purdue University in 1970.

After completing pilot training, he flew 177 combat missions in Southeast Asia in 1972 while stationed at Udorn, Thailand. In 1973, he flew F-4's and in 1975 attended the USAF Test Pilot School at Edwards. In 1977-78 he was an instructor pilot at the USAF Test Pilot School. He has logged over 4,000 hours flying time and 105 hours in space.

Jeffrey A. Hoffman, 45, will serve as Mission Specialist 1 (MS1). Selected as an astronaut in 1978, he was born in Brooklyn, N.Y. STS-35 will be his second Shuttle flight.

Hoffman was a Mission Specialist aboard Discovery on STS-51D, which launched from the Kennedy Space Center in April 1985. On this mission, he made the first STS contingency spacewalk, in an attempted rescue of the malfunctioning Syncom IV-3 satellite.

Hoffman graduated from Scarsdale High School, Scarsdale, N.Y., and received a bachelor of arts degree in astronomy from Amherst College in 1966. He received a doctor of philosophy in astrophysics from Harvard University in 1971 and a masters degree in materials science from Rice University in 1988.

At NASA, Hoffman has worked as the astronaut office payload safety representative. He also has worked on extravehicular activity (EVA), including the development of a high-pressure space suit.

John M. "Mike" Lounge, 43, will be Mission Specialist 2 (MS2). Selected as an astronaut in 1980, Lounge considers Burlington, Colo., to be his hometown. He will be making his third Shuttle flight.

Lounge was a mission specialist on STS-51I conducted in August 1985. During that mission his duties included deployment of the Australian AUSSAT communications satellite and operation of the remote manipulator system (RMS) arm. The crew deployed two other communications satellites and also performed a successful on-orbit rendezvous and repair of the ailing SYNCOM IV-3 satellite. His second flight was aboard Discovery on STS-26 in September 1988.

Lounge graduated from Burlington High School in 1964 and received a bachelor of science degree in physics and mathematics from the U.S. Naval Academy in 1969 and a master of science degree in astrogeophysics from the University of Colorado in 1970. At NASA, Lounge now serves as Chief of the Space Station Support Office which works with design and operation of the Freedom space station.

Robert Allan Ridley Parker, 53, will serve as Mission Specialist 3 (MS3). Selected as an astronaut in 1967, he grew up in Shrewsbury, Mass., and will be making his second Shuttle flight.

Parker was a member of the astronaut support crews for Apollo 15 and 17 missions. He served as a mission specialist on Columbia's sixth space flight, STS-9, in November 1983 which was the first Spacelab mission.

Parker attended primary and secondary schools in Shrewsbury, Mass.; received a bachelor of arts degree in astronomy and physics from Amherst College in 1958, and a doctorate in astronomy from the California Institute of Technology in 1962.

Samuel T. Durrance, 46, will serve as a Payload Specialist. Durrance is a research scientist in the Department of Physics and Astronomy at Johns Hopkins University, Baltimore, Md. He considers Tampa, Fla., his hometown.

Durrance has made International Ultraviolet Explorer satellite observations of Venus, Mars, Jupiter, Saturn and Uranus. He helped develop special pointing techniques needed to observe solar system objects with that satellite. His main astronomical interests are in the origin and evolution of planets, both in this solar system and around other stars.

Durrance received a bachelor of science degree and a master of science degree in physics from California State University and a doctor of philosophy degree in astrogeophysics from the University of Colorado.

Ronald A. Parise, 38, also will serve as a Payload Specialist. Parise is a senior scientist in the Space Observatories Department, Computer Science Corporation in Silver Spring, Md. He is a member of the research team for the Ultraviolet Imaging Telescope, one of the instruments scheduled for flight as part of the Astro payload. He is from Warren, Ohio.

Parise has participated in flight hardware development, electronic system design and mission planning activities for the Ultraviolet Imaging Telescope project. He is pursuing his astronomical research interests with the International Ultraviolet Explorer satellite under a NASA grant. Parise also will conduct the Shuttle Amateur Radio Experiment (SAREX) during the STS-35 mission.

He received a bachelor of science degree in physics, with minors in mathematics, astronomy and geology from Youngstown State University, Ohio, and a master of science degree and a doctor of philosophy degree in astronomy from the University of Florida.

STS-35 MISSION MANAGEMENT

Office of Space Flight

Dr. William B. Lenoir - Associate Administrator
Joseph B. Mahon - Director, Flight Systems
Robert L. Crippen - Director, Space Shuttle
Leonard S. Nicholson - Deputy Director, Space Shuttle (Program)
Brewster Shaw - Deputy Director, Space Shuttle (Operations)

Office of Space Science and Applications

Dr. Lennard A. Fisk - Associate Administrator
Alphonso V. Diaz - Deputy Associate Administrator
Robert Benson - Director, Flight Systems Division
Dr. Charles Pellerin, Jr. - Director, Astrophysics Division
William Huddleston - Astro Program Manager
Dr. Edward Weiler - Astro Program Scientist
Dr. Geoffery Clayton - Deputy Program Scientist

Office of Space Operations

Charles T. Force - Associate Administrator
Eugene Ferrick - Director, Tracking & Data Relay Satellite Systems Division
Robert M. Hornstein - Director, Ground Networks Division

AMES RESEARCH FACILITY

Dr. Dale L. Compton - Director
Victor L. Peterson - Deputy Director

AMES-DRYDEN FLIGHT RESEARCH FACILITY

Martin A. Knutson - Site Manager
Theodore G. Ayers - Deputy Site Manager
Thomas C. McMurtry - Chief, Research Aircraft Operations Division
Larry C. Barnett - Chief, Shuttle Support Office

Goddard Space Flight Center

Dr. John W. Townsend, Jr. - Director
Peter T. Burr - Director of Flight Projects
Dale L. Fahnestock - Director of Mission Operations and Data Systems Directorate
Dr. Theodore Gull - Astro Mission Scientist
Frank Volpe - BBXRT Manager
Bruce Thoman - BBXRT Operations Manager
Peter Serlemitosos - BBXRT Principal Investigator
Theodore Stecher - UIT Principal Investigator

Johnson Space Center

Aaron Cohen - Director
Eugene F. Kranz - Director, Mission Operations
Franklin Brizzolara - Payload Integration Manager

Kennedy Space Center

Forrest S. McCartney - Director
Jay Honeycutt - Director, Shuttle Management & Operations
Robert B. Sieck - Launch Director
John T. Conway - Director, Payload Management & Operations
Joanne H. Morgan - Director, Payload Project Management
Robert Sturm - Astro-1 Launch Site Support Manager

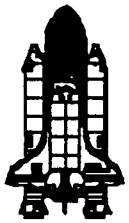
LANGLEY RESEARCH CENTER

Richard H. Petersen - Director
W. Ray Hook - Director for Space
James P. Arrington - Chief, Space System Division

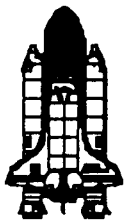
Marshall Space Flight Center

Thomas J. Lee - Director
Jack Jones - Astro Mission Manager
Stuart Clifton - Assistant Mission Manager
Dr. Eugene Urban - Deputy Mission Scientist
Thomas Rankin - Payload Operations Director
Fred Applegate - Payload Operations Director
Steven Noneman - Payload Operations Director

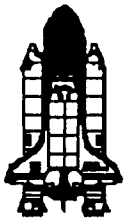
UPCOMING SPACE SHUTTLE FLIGHTS



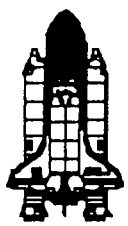
MISSION: STS-38
DATE: July 9, 1990
ORBITER: Atlantis
PAYLOADS: Dedicated
Department of
Defense Mission



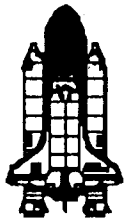
MISSION: STS-37
DATE: Nov. 1, 1990
ORBITER: Atlantis
PAYLOADS: GRO
SSBUV-02
CETA
DURATION: 5 days



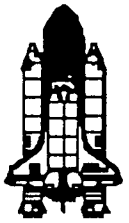
MISSION: STS-40
DATE: August 29, 1990
ORBITER: Columbia
PAYLOADS: SLS-01
GAS
DURATION: 9 days



MISSION: STS-42
DATE: Dec. 12, 1990
ORBITER: Columbia
PAYLOADS: IML-01
IMAX
GAS
DURATION: 9 days



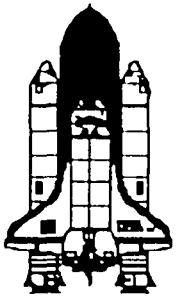
MISSION: STS-41
DATE: October 5, 1990
ORBITER: Discovery
PAYLOADS: Ulysses
SSCE-01
Chromex-02
DURATION: 5 days

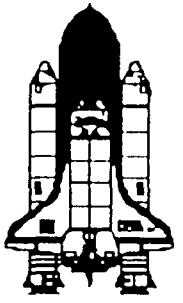


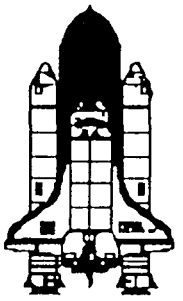
MISSION: STS-39
DATE: January 31, 1991
ORBITER: Discovery
PAYLOADS: AFP-675
IBSS
STP-01 / MPEC
DURATION: 8 days

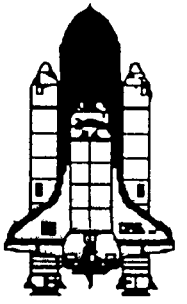
SHUTTLE FLIGHTS AS OF APRIL 1990

35 TOTAL FLIGHTS









	Challenger OV-099	Columbia OV-102	Discovery OV-103	Atlantis OV-104
12				
11				
10	51-L 1/28/86		STS-31 4/24/90 4/29/90	
09	61-A 10/30/85 11/6/85	STS-32 1/9/90 1/20/90	STS-33 11/22/89 11/27/89	
08	51-F 7/29/85 8/6/85	STS-28 8/8/89 8/13/89	STS-29 3/13/89 3/18/89	
07	51-B 4/29/85 5/6/85	61-C 1/12/86 1/18/86	STS-26 9/29/88 10/3/88	
06	41-G 10/5/84 10/13/84	STS-9 11/28/83 12/8/83	51-I 8/27/85 9/3/85	STS-36 2/28/90 3/4/90
05	41-C 4/6/84 4/13/84	STS-5 11/11/82 11/16/82	51-G 6/17/85 6/24/85	STS-34 10/18/89 10/23/89
04	41-B 2/3/84 2/11/84	STS-4 6/27/82 7/4/82	51-D 4/12/85 4/19/85	STS-30 5/4/89 5/8/89
03	STS-8 8/30/83 9/5/83	STS-3 3/22/82 3/30/82	51-C 1/24/85 1/27/85	STS-27 12/2/88 12/6/88
02	STS-7 6/18/83 6/24/83	STS-2 11/12/81 11/14/81	51-A 11/7/84 11/15/84	61-B 11/26/85 12/3/85
01	STS-6 4/4/83 4/9/83	STS-1 4/12/81 4/14/81	41-D 8/30/84 9/4/84	51-J 10/3/85 10/7/85

NASA News

National Aeronautics and
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For Release:
May 3, 1990

RELEASE: 90-64

TWO COMMUNICATIONS SATELLLITES TO BE LAUNCHED IN MAY

Two Mulitiple Access Communications Satellites (MACSATs) are scheduled to be launched by NASA aboard a Navy-owned Scout rocket on May 9 from Vandenberg Air Force Base, Calif. The 90-minute launch window opens at 1:49 p.m., EDT. The program is sponsored by the Department of Defense Advanced Research Projects Agency (DARPA).

The MACSATs, developed by Defense Systens Inc., will provide a global store-and-forward message relay capability at UHF frequencies for a variety of Department of Defense users during test demonstrations to be conducted this year by DARPA.

The Scout program is managed by NASA's Langley Research Center, Hampton, Va. The 73-feet-long, four stage, solid-propellant rocket motor launch vehicle is built by the Missiles Division of LTV Missiles and Electronics Group, Dallas, Texas. First launched in 1960, Scout has had 98 successful missions in 112 attempts, including 56 successes in 57 launches since 1967.

- end -

NOTE TO EDITORS: The Scout/MACSAT launch will be carried live on NASA Select television via Satcom F-2R, Transponder 13, C-Band located at 72 degrees west longitude, frequency 3960.0 MHz, vertical polorization, audio monaural 6.8 MHz. Media representatives may view the launch in the NASA Headquarters auditorium, 400 Maryland Ave., S.W., 6th floor, room 6104.

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202-453-8400

Debra J. Rahn
Headquarters, Washington, D.C.
(Phone: 202/453-8455)

For Release:
May 7, 1990

RELEASE: 90-65

TRULY PRESENTED SPACE MODEL BY CANADIAN SCHOOL

NASA Administrator Richard H. Truly met today in Ottawa with representatives from the Highly Gifted and Talented Student program of the Manitoulin Island Board of Education, Ontario, Canada. Seventh grade student J.D. Wisner from C.C. Mclean Public School and Dianna Shaffer, program teacher, represented the students and faculty.

As a part of their curriculum, Shaffer's students have spent the last year studying the development of NASA since its inception in 1958 and each student has completed one or two authentic scale models of a rocket, Skylab, the Space Shuttle and the Space Station. Wisner presented Admiral Truly with a scale model of Skylab.

In recognition of the student's outstanding efforts to expand their knowledge and understanding of space exploration, Truly presented the school with a framed montage of photos from NASA's Space Shuttle mission 41G flown in October 1984 whose crew included Canada's first astronaut, Marc Garneau. Also included with the photos were flags of the United States and Canada flown on that Space Shuttle mission.

Truly was in Canada meeting with Dr. Larkin Kerwin, President, Canadian Space Agency, to discuss ongoing cooperative projects. Truly also met with Canada's Minister of Industry, Science and Technology, the Honorable Benoit Bouchard and Canada's Minister of Science, the Honorable William Winegard.

- end -

90-66

ROENTGEN SATELLITE
(ROSAT)

PRESS KIT
MAY 1990

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DLR ROSAT Project Office
Cocoa Beach, Fla.
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RELEASE: 90-66

ROSAT SPACECRAFT TO EXPLORE HIGH ENERGY UNIVERSE

Continuing a program in which it has been a pioneer, NASA will join with the U.S. Air Force and West Germany to launch the Roentgen Satellite (ROSAT) to expand human knowledge of the high-energy processes within the universe. ROSAT is scheduled for launch aboard a McDonnell Douglas Delta II expendable launch vehicle from Cape Canaveral Air Force Station, Fla., no earlier than May 31.

ROSAT, a cooperative program between the United States and the Federal Republic of West Germany, originated from a 1975 proposal to the Bundesminister fur Forschung und Technologie (BMFT) from scientists at the Max-Planck-Institut fur Extraterrestrische Physik (MPE) in Garching, FRG. The mision will examine X-rays emitted by cosmic sources. The mission's objective is a detailed survey of X-ray sources across the sky, followed by studies of some 1,000 of the anticipated 50,000 to 100,000 sources that will be detected.

X-rays from astronomical bodies cannot be observed from ground level because the Earth's atmosphere blocks them. Only instruments beyond the atmosphere can measure the X-ray sky, making X-ray astronomy a true product of the space program.

Because X-ray emission is characteristic of very high temperatures, X-ray astronomy allows scientists to study high-energy processes in the universe. Such high-temperature processes represent a small fraction of the energy generated by ordinary stars like the sun, but they can dominate the output of supernova remnants, quasars and celestial systems containing neutron stars or black holes.

NASA helped pioneer the development of X-ray astronomy, but the last NASA X-ray mission was the High Energy Astronomy Observatory (HEAO-2), nicknamed the Einstein Observatory because it was launched in 1979, the centennial year of physicist Albert Einstein's birth. A landmark in the development of astronomy, the Einstein Observatory provided the first true images of X-ray-emitting objects.

- end general release -
background information follows

ROSAT Science Objectives

The ROSAT all-sky survey, which will take 6 months to complete, will use the imaging telescopes to measure positions of X-ray and extreme ultraviolet (XUV) sources to an accuracy of 0.5 arc minutes, while obtaining fluxes and spectral information.

The second stage of the mission will consist of pointed observations of selected sources. Sources are chosen for the pointed phase based on proposals submitted by the astronomical community for peer review. Outlined below are some of the topics to be explored in the pointed phase of observations.

Different types of normal stars apparently emit X-rays by different mechanisms. Relatively cool stars like the sun emit X-rays from an outer corona of hot, low-density gas (visible when the bright chromosphere is masked, as in an eclipse). X-rays are thought to be produced in the stellar corona by interactions with the stellar magnetic field, heating gases to 1 million degrees or more. Scientists do not fully understand the corona phenomenon, but with ROSAT they can study the corona effect in the stars.

Hot stars, which are 5 to 10 times hotter than the sun and 10 to 100 times more massive, also are X-ray emitters. In these stars it is believed that stellar winds carry shock-heated parcels of gas that emit X-rays.

Very young stars are born in regions of contracting gas and dust that generally block astronomers view of X-rays. As a molecular cloud condenses, temperatures climb, nuclear reactions begin and a star bursts into life. The nature of X-ray emission from such young stars is a mystery that ROSAT will investigate.

Supernova remnants, the remains of exploded massive stars, can tell scientists a great deal about the evolution of a star. The source of the explosion, the outward propagation, velocity and dynamics of the ejecta, the atomic composition of the debris and the evolution of the collapsed core are all questions of interest to astronomers. Supernova 1006, observed in the year 1006 AD, was the earliest recorded observation of a supernova in this galaxy. X-radiation detected in the constellation Lupus is thought to be the remnant of that explosion. ROSAT's high-resolution observations may show details of the distribution of material in this remnant.

Compact objects such as white dwarfs, neutron stars and black holes evolve from dying stars when gravity has reduced them to the minimum possible volume for their mass. The gravitational fields around black holes are so strong that not even light can escape, and the existence of black holes is only established by their effects on objects close to them.

The high spatial resolution of the ROSAT telescope will allow determination of the first accurate positions for compact X-ray sources. Many stars exist in binary systems, rotating around one another, with the compact member of the binary attracting a flow of X-ray emitting material from its companion. Detailed analysis of the X-ray data will give information about the size and shape of the system.

Normal galaxies, both spiral and elliptical, produce X-rays. In spirals, the X-rays represent the accumulated emission from individual X-ray sources within the galaxy. ROSAT, with its improved sensitivity and spatial resolution, will allow detection of these individual sources in many galaxies. X-rays from elliptical galaxies, however, appear to originate in gas several millions of degrees in temperature. This gas is gravitationally confined, and a knowledge of its temperature and density will enable scientists to determine the mass of the galaxy.

When comparing this mass with the mass of the stars comprising a galaxy, the difference will be a measure of dark matter associated with the galaxy. The effects of dark matter were detected by the Einstein Observatory for a few galaxies. The greater sensitivity, spatial and spectral resolution of ROSAT will increase the sample of galaxies studied and place stronger constraints on the determination of mass and distribution of dark matter in elliptical galaxies.

Active Galactic Nuclei (AGN) make up a small percent of all galaxies. Very large amounts of energy are released from their nuclei, much more than can be accounted for by the stars they contain. The most well known class of AGN are quasars, which can be observed at very large distances because they are among the most luminous objects in the Universe. The large emissions from AGNs suggest they are powered by the release of gravitational potential energy as matter accretes onto a massive central object, thought to be a black hole.

Current ideas favor the formation of a disc of accreting matter, heated by viscous forces as material is pulled inward onto the black hole. Soft X-rays may originate in the hypothesized accretion disk. ROSAT's soft-X-ray timing and spectral data may provide valuable information on the size and physical conditions in this disk. Although extended optical and radio emitting regions have been found in many AGN, only a few cases of extended X-ray emission are known. ROSAT's high spatial resolution and sensitivity will allow a detailed study of such phenomena, giving scientists clues to their physical origin.

The first X-ray astronomy experiments discovered that clusters of galaxies emit extensive X-rays. These emissions originate in the multi-million degree gas permeating each cluster, and the mass of this gas exceeds the mass of visible material. The total mass of a cluster can be measured in the same way as for elliptical galaxies. ROSAT will make it possible to estimate mass for lower temperature clusters emitting in the soft X-ray regime.

The X-ray background comprises a uniform emission on which individual X-ray sources are superimposed. This background radiation may be either an intergalactic gas smoothly distributed throughout the Universe or a large number of individual sources too numerous and weak to be resolved by current instruments. The simplest way to resolve this question is to observe the background with increasingly sensitive and high spatial-resolution detectors to try to identify any individual sources resolved.

Division Of Tasks

Germany

Spacecraft	Dornier System (Prime Contractor) Messerschmitt-Boikow-Blohm Telefunken
X-Ray Mirror Assembly	Carl Zeiss
Focal Plane Assembly	MPE Garching
Two Position Sensitive Proportional Counters	MPE Garching
Spacecraft Operations	DLR-GSOC Oberpfaffenhofen

USA

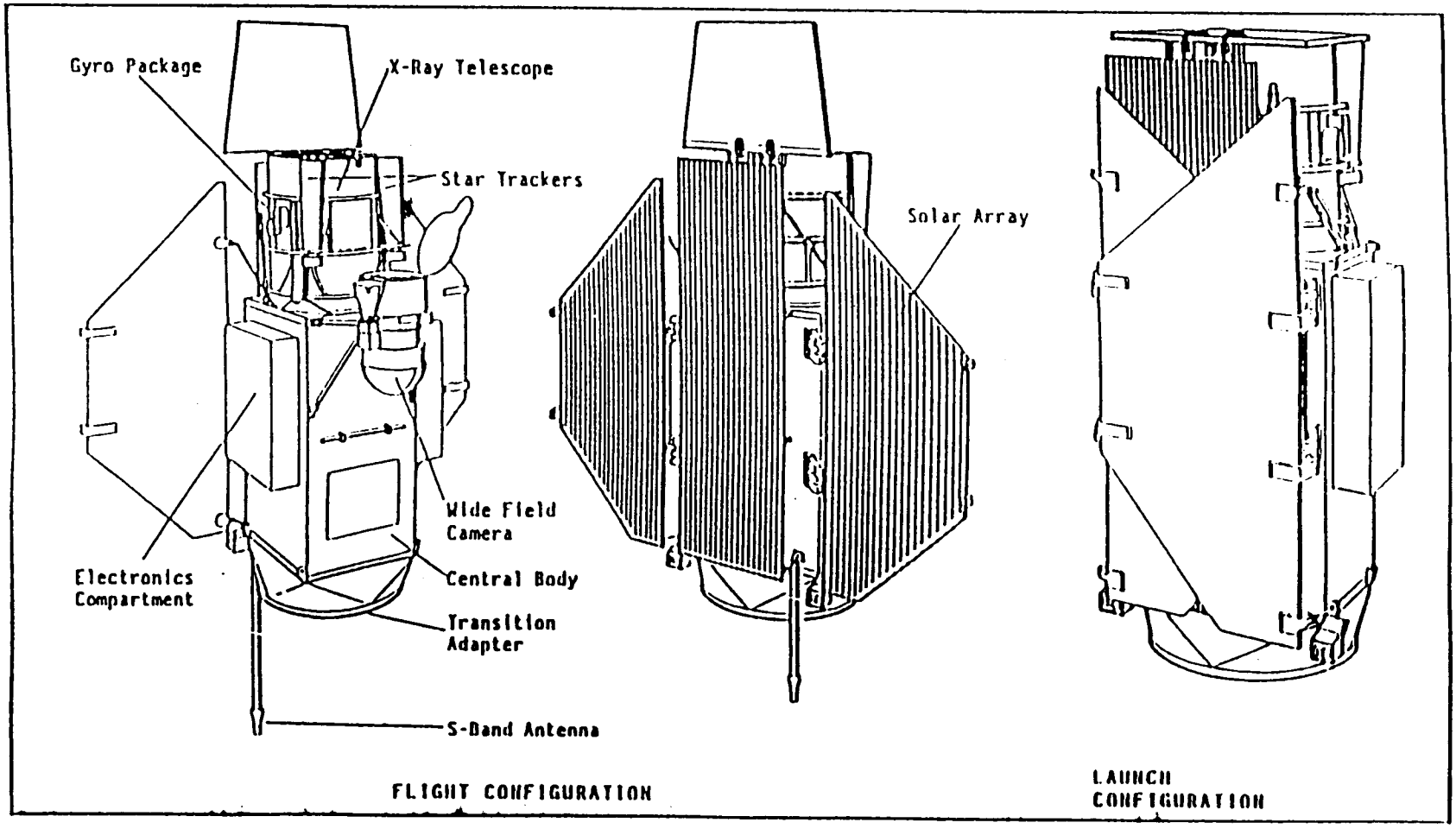
Delta II Launch Vehicle	McDonnell Douglas/USAF/NASA
High Resolution Imager	SAO/GSFC

UK

Wide Field Camera	University Of Leicester and a Consortium of UK institutes

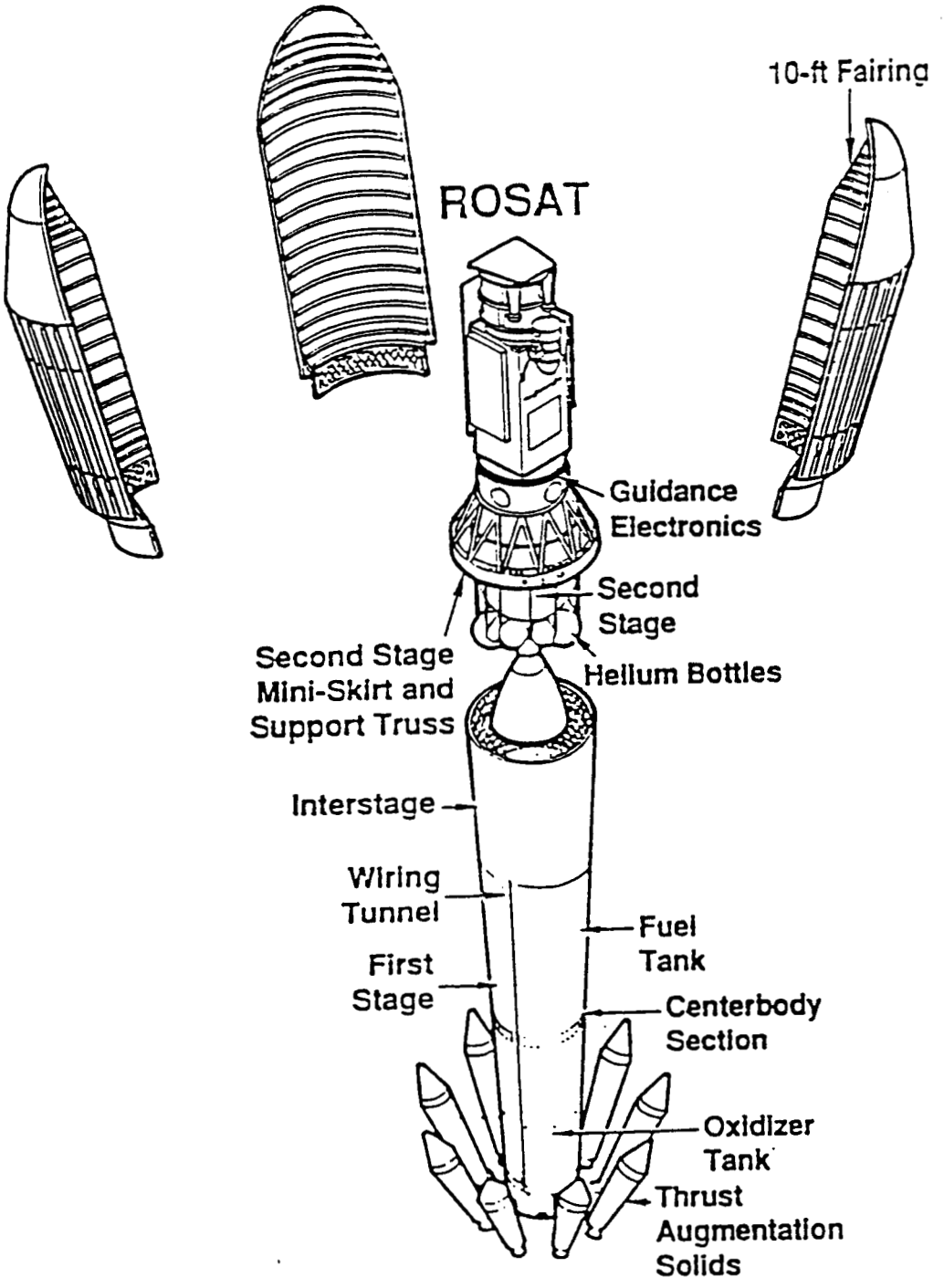
ROSAT MISSION TIMELIME

Activity	Time (Min:Sec)	Altitude	Downrange Distance	Velocity (MPH)
Six solid rocket motors burnout	0:56	39,254 ft.	16,422 ft	1,220
Three solid rocket motors ignite	1:01	46,543 ft.	21,275 ft.	1,175
Jettison 3 solid motor casings	1:02	9.07 sm	4.21 sm	1,185
Jettison 3 solid motor casings	1:03	9.34 sm	4.41 sm	1198
Three solid motors burn out	1:56	28.7 sm	29.23 sm	3396
Jettison 3 solid motor casings	2:02	31.4 sm	34.14 sm	3517
Main engine cutoff (MECO)	4:25	86.9 sm	281.33 sm	11,663
1st separation	4:33	91.3 sm	306.29 sm	11,665
2nd stage ignition	4:38	94.3 sm	323.43 sm	11,646
Fairing jettison	4:43	96.8 sm	338.89 sm	11,671
2nd stage engine cutoff (SECO 1)	11:10	185.4 sm	1,753.7 sm	16,711
2nd stage ignition	38:02	360.7 sm		15,977
2nd stage engine cutoff (SECO 2)	38:14	360.8 sm		16,227
Spacecraft separation	43:00	359.8 sm		16,231



ROSAT Flight and Launch Configurations

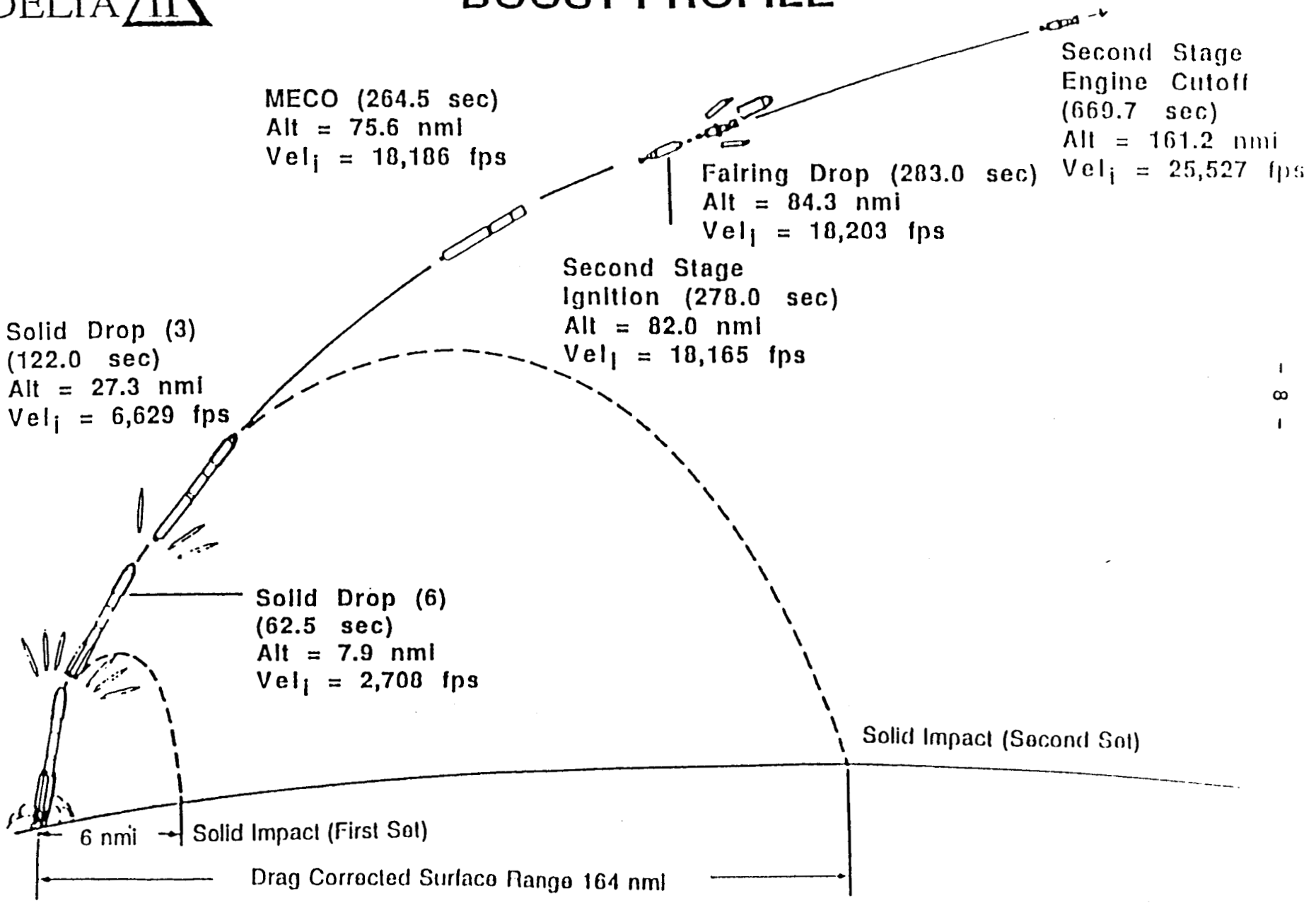
-more-



Launch Vehicle Schematic

DELTA II

ROSAT SPACECRAFT MISSION BOOST PROFILE



-more-

The Instruments

The heart of the ROSAT spacecraft is the grazing-incidence X-ray telescope (XRT) developed in West Germany. The XRT focuses low energy or RsoftS X-rays in the energy range of 0.1 to 2 kilo electron volts (keV), corresponding to wavelengths of 100 to 6 Angstroms, onto detectors in XRTUs focal plane.

This telescope consists of a four-fold nested Wolter type I mirror system with an 33-inch diameter and a 94-inch focal length, optimal with respect to survey sensitivity and on-axis collecting area at 1 keV. A carousel in the focal plane assembly carries two virtually identical West German Position Sensitive Proportional Counters (PSPC) and a single U.S.-supplied High Resolution Imager (HRI).

As a result of a separate agreement between West Germany and the United Kingdom, ROSAT also will carry a longer wavelength telescope supplied by the U.K. called the Wide Field Camera (WFC). The WFC extends the measuring range to the extreme ultraviolet (XUV) region, with response over the energy range 0.04 to 0.2 keV (300 to 60 Angstroms). The WFC will view the sky simultaneously with the XRT, so that it can measure any XUV flux that might accompany X-ray emissions, in addition to discovering new sources that radiate primarily in the XUV during the survey.

X-ray Sky Survey

A 2-month instrument calibration period will follow ROSAT's launch. After calibration, the spacecraft will completely survey the celestial sphere. The sky survey is performed by continuously scanning great circles 2 degrees wide and perpendicular to the Earth-sun line, which allows full-sky coverage in 6 months. The scan rate of one rotation per orbit will avoid wasted time due to Earth occultation. ROSAT's X-ray survey will be the first by a true imaging telescope, and scientists anticipate that there will be almost a 100-fold increase over the number of sources detected previously in surveys conducted with mechanically collimated counters.

The X-ray sky survey will be performed with the PSPC at the focus of the XRT. Its relatively large field of view (2 degrees circular compared to the 1 degree per day change in the direction of the Earth-sun line) and high sensitivity are ideally suited to this aspect of the mission. The X-ray survey data will be analysed and published by the Max-Planck Institut fur Extraterrestrische Physik.

The concurrent XUV survey, performed by the WFC with its 5-degree field, will be the very first conducted in its portion of the electromagnetic spectrum and will be capable of detecting sources at a level 1,000 times weaker than the brightest known XUV source, the white dwarf star HZ43. The results of the XUV survey will be analysed and published by the WFC consortium.

Pointed Observations

After the survey, the mission will be devoted to pointed observations. The nominal mission lifetime contains 1 year of pointed observations, but the spacecraft orbit has been chosen to guarantee at least 1 additional year of observations. The PSPC counter gas is the only consumable in the payload, and the gas should not be exhausted for at least 2 years of pointed operation.

U.S. guest investigators have been allocated 50 percent of the time allotted for pointed observations with the XRT, with the remaining time being shared by the West Germans (38 percent) and the British (12 percent). Guest investigators can choose the pointing directions, instrument parameters and durations of the observations. After 1 year of proprietary ownership, all pointed-mode X-ray data enter the public domain and are available for archival research.

ROSAT Launch Operations

The 6555th Aerospace Test Group, U.S. Air Force Eastern Space and Missile Center, is responsible for the preparation and launch of the Delta II which will carry the 5333 lb. (2424 kg) ROSAT into a circular orbit of 359 statute miles (580 km) with an inclination of 53 degrees.

ROSAT spacecraft pre-launch processing was accomplished by the West German Institute for Air and Space Flight cooperating with the Kennedy Space Center's Payloads Operations Directorate. Processing included functional testing, installation of the wide field camera and interface tests with the German mission control center at Oberpfaffenhofen, near Munich.

Launch operations will be conducted from the Complex 17 blockhouse by a USAF/McDonnell Douglas team under the direction of the 6555th Aerospace Test Group. The hypergolic propellants for the second stage will be loaded approximately three days prior to launch. The RP-1 (kerosene) fuel for the first stage and the supercold liquid oxygen oxidizer for the first stage will be loaded during the terminal countdown.

NASA will oversee the launch vehicle and support ROSAT flight preparations. A Kennedy Space Center launch manager will represent NASA during vehicle preparations and countdown and serve as liaison with the Air Force. The launch manager will be located in the Mission Director's Center on CCAFS to monitor launch countdown operations and will provide the final NASA concurrence for launch to the USAF launch director.

DELTA II Launch Vehicle

A United States Air Force Delta II 6920-10 expendable launch vehicle, featuring the largest payload fairing flown on a Delta to date, will lift ROSAT into low-Earth orbit. Based on the Titan fairing McDonnell Douglas Space System Company (MDSSC) has built for years, the 10-foot-diameter fairing will be the first three-section fairing used on a Delta vehicle. Fairings previously used on Deltas have consisted of two sections. This configuration accommodates ROSAT and other payloads requiring a larger volume than offered by the 9.5-foot and 8-foot fairings flown previously. NASA funded the development of the 10-foot fairing for the Delta rocket.

The fairing uses the MDSSC contamination-free thruster joints to separate into three sections. MDSSC fairings, which are manufactured at the MDSSC plant in Pueblo, Colo., have a 100 percent success record.

The ROSAT launch will be the 10th flight for the Delta II. Delta's origins reach back to the mid-1950s, when the U. S. Air Force developed the Thor intermediate-range ballistic missile. NASA later modified the Thor, a single-stage, liquid-fueled missile, for the Delta launch vehicle. The two-stage Delta II carrying ROSAT consists of four major assemblies: the first stage, including nine strap-on solid rocket motors, the interstage, the second stage and the payload fairing. Initial system improvements incorporated into the Delta II include a 12-foot extension in the first-stage tanks for added propellant capacity and the use of Morton-Thiokol Caster IVA solid rocket boosters.

The Delta II is 123.4 feet tall and 8 feet in diameter. The payload fairing is 26 feet tall and 10 feet in diameter. The first-stage main engine has a liftoff thrust of 207,000 pounds, and each of the nine solid strap-on motors has a sea-level thrust of 97,070 pounds. The main engine and six of the nine solid motors are burning at liftoff, providing a total liftoff thrust of 789,420 pounds. The second set of three solid strap-on motors is ignited during the first stage burn. The second-stage engine has a vacuum-rated thrust level of 9,645 pounds.

Several major subcontractors contribute to the Delta vehicle built by MDSSC: The Rocketdyne Division of Rockwell International in Canoga Park, Calif., is responsible for the first-stage main engine; Aerojet TechSystems Co. in Sacramento, Calif., builds the second-stage engine; Morton Thiokol of Huntsville, Ala., manufactures the solid rocket boosters; and Delta Systems of Goleta, Calif., produces the guidance computer.

NASA's Role

The Goddard Space Flight Center (GSFC), Greenbelt, Md., is the lead NASA center for the U.S. portion of ROSAT. GSFC managed the development and delivery of the High Resolution X-ray Imager fabricated at the Smithsonian Astrophysical Observatory, Cambridge, Mass., and assured the instrument's integration into the XRT focal plane. GSFC also managed all aspects of launch vehicle preparation and its mating to the spacecraft.

NASA will provide initial spacecraft tracking and orbit determination until these tasks can be assumed by West Germany at its ground station at Weilheim and Operations Control Center at Oberpfaffenhofen a few hours after launch. NASA also is prepared to provide, on request, spacecraft engineering data capture and transmission to Germany in case of an emergency during the life of the spacecraft.

GSFC is developing a comprehensive U.S. ROSAT Science Data Center (USRSDC), and is responsible for providing all U.S. guest investigators with their data and the software necessary for analysis. Data centers will be established at both the GSFC and at the Smithsonian Astrophysical Observatory for the convenience of guest investigators, but investigators also will be able to perform most of their analyses at their home institutions. GSFC also is establishing an accessible ROSAT data archive that can be used in conjunction with data sets from other missions.

The USRSDC supports astronomers in their preparation of proposals for pointed phase observations through the Mission Information and Planning System (MIPS). MIPS is a software system that provides a proposer with information such as observation times appropriate for a given source. It was used by 137 different astronomers across the U.S. for the first round of proposals. Following the results of a questionnaire distributed to users, the USRSDC staff is making improvements in preparation for the second round of proposals.

In the first round, 354 proposals were received by NASA. The USRSDC assisted NASA Headquarters in the review and selection of these investigations by performing technical evaluations and organizing the independent peer review. USRSDC staff were on hand during the peer review to answer technical questions.

GSFC is responsible for processing and distributing ROSAT pointed-phase data. Initially all data are processed at the German Space Operation Center (GSOC) in Oberpfaffenhofen, West Germany.

Video tapes containing master data records are then shipped to the Max Plank Institute in Garching, West Germany, and to GSFC, where they are processed to create the files for distribution to guest investigators. These files also are archived by the USRSDC and will be made generally available 1 year after calibrated data has been delivered to the investigator.

ROSAT/DELTA TEAM

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For Release:
May 8, 1990

RELEASE: 90-067

NASA STUDIES EFFECT OF TROPICAL-FOREST BURNING ON GREENHOUSE GAS

Cattle pastures that were once Brazilian tropical forests may be contributing to the buildup of greenhouse gases in the atmosphere, NASA scientists report.

A team headed by Dr. Pamela Matson of Ames Research Center, Moffett Field, Calif., sampled nitrous oxide levels in three ecosystems within Brazil's Amazon Basin: undisturbed rain forests, recently cleared and burned areas and land converted to cattle pastures.

The researchers found that nitrous oxide emissions from recently cleared areas were not significantly higher than those from undisturbed rain forest. However, annual emissions from pastures were three times as high as levels obtained from representative samples of tropical forest.

Nitrous oxide is a greenhouse gas, trapping heat close to the Earth's surface that would otherwise radiate into space. Various studies have shown nitrous oxide concentrations in the atmosphere are increasing by 0.2 to 0.3 percent each year, but investigators, studying global climate, have been unable to explain the increase.

"This is the first study showing the potential importance of tropical land use changes on greenhouse gases other than carbon dioxide," said Dr. Matson. "Given that tropical deforestation is occurring so rapidly, this effect could have global significance."

- more -

Recent estimates by the United Nations Food and Agriculture Organization and the U.S. National Academy of Sciences indicate approximately 15 to 20 million acres of tropical forests are cleared each year for pasture and agricultural use around the world. Another 35 million acres of regrown forest are cleared annually for slash-and-burn agriculture and for other short-term uses.

Nitrous oxide is a byproduct of the alteration of nitrogen by microbes in the soil. When it reaches the upper atmosphere, nitrous oxide also contributes to the breakdown of the ozone layer.

The clearing of tropical forests illustrates the complex environmental interactions related to global climate change. In addition to possibly increasing greenhouse-gas emissions, the clearing of forests removes a vast carbon "sink" by destroying large numbers of plants that remove carbon dioxide from the atmosphere through photosynthesis. The burning of the trees after clearing directly releases vast quantities of carbon dioxide, another greenhouse gas, into the atmosphere. The net effect of such clearing on atmospheric chemistry, however, has never been precisely quantified, and it's exact effect on global climate remains uncertain.

The findings were reported by researchers for NASA's Ames Research Center, Moffett Field, Calif.; Brazil's Institute for Research in the Amazon; and Stanford University, Palo Alto, Calif. The report was based on data gathered in the Amazon Basin in 1987 and 1988. The study's research team included Dr. Gerald Livingston from Ames, Flavio and Regina Luizao of the Brazil Institute and Dr. Peter Vitousek of Stanford. The study was supported by the Biospheric Research Program within NASA's Office of Space Science and Applications in collaboration with the Brazilian Institute for Space Research, San Jose dos Campos, Brazil.

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For Release:
May 14, 1990

RELEASE: 90-68

NASA AWARDS CONTRACT TO DEVELOP ADVANCED SOLID ROCKET MOTOR

NASA's Marshall Space Flight Center, Huntsville, Ala., on Friday, May 11, awarded an approximately 5-year-long contract to Lockheed Missiles & Space Co., Sunnyvale, Calif., for the design, development, test and evaluation of the Space Shuttle advanced solid rocket motor (ASRM).

The new Shuttle motor will be phased in, during the mid-1990s, as a replacement for the current redesigned solid rocket motor. It will provide improved safety, reliability and performance for the Shuttle flight program well into the 21st Century.

The value of the basic contract is $971 million and calls for production of 20 of the new rocket motors -- one as a nonflying, form-and-fit "pathfinder," seven for ground test-firing and qualification, and 12 (6 flight sets) for Shuttle launches.

Under an option for production of additional ASRM flight motors, NASA could order up to 88 motors (44 sets) to support the Shuttle flight program. The additional production option could be valued at up to $1.388 billion if the maximum of 88 motors is purchased.

Lockheed is teamed with Aerojet Space Boosters Co., Sacramento, Calif., as its principal subcontractor for development of the advanced motor, and with Rust International, Birmingham, Ala., as the facility construction contractor.

- more -

Preliminary design efforts on the project have been underway since December 1989 under interim contracts between NASA and Lockheed -- one for hardware and the other for facilities design activities.

The development schedule calls for delivery of the first flight set of motors in 1995. NASA plans to phase-in the ASRM hardware over approximately a 3-year period for replacement of the redesigned solid rocket motor.

Facilities for production and testing of the ASRM hardware will be constructed under a companion facilities contract with Lockheed, planned for award in the near future. The facilities construction contract is to be an approximately $292-million effort, plus an additional $236 million to provide for purchase and installation of tooling and equipment for ASRM production.

Major facilities to be built for the project will be for production of motor segments, nozzles and associated hardware, at a rate of up to 30 motors per year. The facilities will be constructed at the Yellow Creek site in extreme northeastern Mississippi near the city of Iuka.

Specialized facilities also will be constructed at the John C. Stennis Space Center near Bay St. Louis, Miss., for ground testing of the ASRM. The Stennis Center long has been NASA's primary testing center for liquid fueled rocket engines and now will have the unique test stands and apparatus required for static firing of powerful solid rocket motors. It also is planned that a part of the manufacturing effort will be done utilizing NASA's existing facilities at the Michoud Assembly Facility outside New Orleans.

The most significant benefits of the new solid rocket motor will be in enhanced reliability, safety and performance for the Shuttle system. The safety and reliability advances will be realized through quality and reproducibility improvements, which in turn will result from using state-of-the-art automation and process-control technology.

In terms of performance, the new motor is intended to provide the Shuttle with a capability to lift heavier payloads into orbit, with a design goal of a 12,000-pound increase over current payload delivery performance.

Signing of the contract between NASA and Lockheed concludes the process of definitization or spelling out in detail the types of work the contractor is required to perform, as well as the resources necessary to accomplish the job as specified.

Lockheed was selected after a review of the technical, management and cost proposals received in response to NASA's August 1988 request for proposals.

Other subcontractors, in addition to Aerojet and Rust International, are: Babcock and Wilcox, headquartered in New Orleans, La. (fabrication of steel cases); Thiokol Corp., Ogden, Utah (production of motor nozzles at NASA's Michoud Assembly Facility in New Orleans); and Lockheed Austin Division, Austin, Texas (supply of support equipment).

The Marshall Space Flight Center has management responsibility for the ASRM and will directly manage performance of the contract.

- end -

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For Release:
May 21, 1990
8 a.m. EDT

N90-34

EDITORS NOTE: DOE AND NASA TO ANNOUNCE JOINT EDUCATION PLANS

Secretary of Energy James D. Watkins, Nobel laureate Dr. Glenn T. Seaborg and NASA Administrator Richard H. Truly will participate in a press briefing on May 22, 11 a.m. EDT, to discuss the final report from Department of Energy's (DOE) Math/Science Education Action Conference held last October. The briefing will be held at DOE's Forrestal building auditorium, 1000 Independence Ave., S.W.

Watkins and Truly will announce and discuss a memorandum of understanding between DOE and NASA to work cooperatively on education programs to help improve the nation's science, engineering and math programs and help attract and retain more young people in these careers.

The DOE Math/Science Education Action Conference was conducted Oct. 8-10, 1989, 2 weeks after President Bush's "Education Summit" with the nation's govenors. Watkins and Seaborg chaired the conference that brought together 250 scientists, educators, business executives and government leaders to develop an action plan for revitalizing math and science education. Truly and representatives from NASA's Educational Affairs Division participated in the October conference.

The conference targets are to improve general math/science literacy in the general public; bring greater numbers of women and minorities into science and technology; and broaden opportunities for students and teachers to experience cutting-edge Federal and private sector science facilities.

- end -

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For Release:
May 24, 1990

RELEASE: 90-71

DOD/NASA ANNOUNCE NATIONAL AERO-SPACE PLANE CONTRACTOR TEAM

The Department of Defense and NASA announced today the immediate establishment of a national team of contractors to continue the challenging research and development of the National Aero-Space Plane (NASP).

With the engineering and technology bases available from Rockwell International, McDonnell Douglas, Pratt and Whitney, General Dynamics and Rocketdyne, the federal government expects to benefit from the synergism of ideas from these five organizations.

As a presidentially directed joint DOD/NASA program, the NASP program objective is to develop and demonstrate hypersonic technologies with the ultimate goal of a single-stage-to-orbit vehicle. These vehicles would be capable of horizontal takeoff and landing and long range, hypersonic flight within the atmosphere.

With the national contractor team, DOD and NASA take a unique first step in formulating a single team of contractors working together to develop technologies for future hypersonic aircraft. The team will conduct the design and development activities necessary to proceed with the X-30 research aircraft and develop a competitive technology base for future systems.

Instead of just one contractor coming forward with concepts in materials, propulsion and structures, this new approach will allow the government and the contractors alike to capitalize on five industry bases of technological development.

The government anticipates that with breakthroughs in technology from efforts such as NASP, the United States will continue to maintain its world leadership position in aerospace technology.

-end-

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For Release:

May 24, 1990
noon EDT

RELEASE: 90-72

SHUTTLE CREWS NAMED FOR 1991 MISSIONS (STS-43, STS-44, STS-45)

Astronaut crew assignments have been made for three Space Shuttle missions scheduled for early to mid-1991, bringing the total number of Shuttle crews currently in training to 12.

Navy Capt. David M. Walker will command a crew aboard the Space Shuttle Atlantis on STS-44, a Department of Defense dedicated flight currently targeted for March 1991. Air Force Lt. Col. Terence T. "Tom" Henricks will serve as pilot. Mission specialists for the flight will be F. Story Musgrave, M.D., Navy Lt. Cmdr. Mario Runco, Jr. and Army Lt. Col. James S. Voss.

Marine Col. Charles F. Bolden, Jr., will command Shuttle flight STS-45 (ATLAS-01), a mission dedicated to studying atmospheric phenomena from a laboratory aboard the Space Shuttle Columbia. Air Force Maj. Brian Duffy will serve as pilot. Mission specialists are payload commander Kathryn D. Sullivan, Ph.D., C. Michael Foale, Ph.D. and Navy Capt. David C. Leestma. Payload specialists for the mission, currently projected for April 1991, are Michael L. Lampton, Ph.D. and Byron K. Lichtenburg, Ph.D. Sullivan, Foale, Lampton and Lichtenburg had been previously named to the flight.

Air Force Col. John E. Blaha will command STS-43, a 5-day mission to deploy the Tracking and Data Relay Satellite, TDRS-E, planned for May 1991. Serving as pilot aboard Discovery will be Navy Lt. Cmdr. Michael A. Baker. Mission specialists will be Shannon W. Lucid, Ph.D., G. David Low and Army Lt. Col. James C. Adamson.

- more -

Walker will make his third Shuttle flight, his second as commander. He flew previously on STS-51A as pilot and as commander for STS-30. Walker was born May 20, 1944, in Columbus, Ga., but considers Eustis, Fla., his hometown.

Henricks, making his first space flight, was born July 5, 1952, in Bryan, Ohio, but considers Woodville, Ohio, his hometown.

Musgrave has flown three times previously on STS-6, STS-51F and STS-33. He was born Aug. 19, 1935, in Boston, Mass., but considers Lexington, Ky., his hometown.

Runco will also make his first space flight. He was born Jan. 26, 1952, in Bronx, N.Y., but considers Yonkers, N.Y., his hometown.

Voss, also making his first flight into space, was born March 3, 1949, in Cordova, Ala., but considers Opelika, Ala., his hometown.

Bolden receives his first command after two previous assignments as pilot for missions STS-61C and STS-31. He was born Aug. 19, 1946, in Columbia, S.C.

Duffy will be making his first trip to space. He was born June 20, 1953, in Boston, Mass.

Sullivan, making her third flight, served as mission specialist for STS-41G and STS-31. She was born Oct. 3, 1951, in Paterson, N.J., but considers Woodland Hills, Calif., her hometown.

Leestma will make his third Shuttle flight, having flown as mission specialist on STS-41G and on STS-28. He was born May 6, 1949, in Muskegon, Mich.

Foale also will make his first space flight. He was born an American citizen on Jan. 6, 1957, in Louth, England, and considers Cambridge, England, his hometown.

Lampton will make his first trip to orbit. He was born March 1, 1941, in Williamsport, Penn.

Lichtenburg will make his second space flight. He served as payload specialist on STS-9 (SL-1). Lichtenburg was born Feb. 19, 1948, in Stroudsburg, Penn.

Blaha has flown twice previously as pilot on STS-29 and STS-33. He was born Aug. 26, 1942, in San Antonio, Texas.

Baker will make his first space flight. He was born Oct. 27, 1953, in Memphis, Tenn., but considers Lemoore, Calif., his hometown.

Low, making his second Shuttle flight, served as mission specialist on STS-32. He was born Feb. 19, 1956, in Cleveland, Ohio.

Adamson has flown previously as mission specialist on STS-28. He was born March 3, 1946, in Warsaw, N.Y., but considers Monarch, Mont., his hometown.

Lucid will make her third flight, having flown as mission specialist on STS-51G and STS-34. She was born an American citizen in Shanghai, China, on Jan. 14, 1943, and considers Bethany, Okla., her hometown.

- end -

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For Release:

May 25, 1990

STS-35 LAUNCH ADVISORY

NASA managers yesterday set May 30 as the launch date for Shuttle Mission STS-35 which will carry the Astro-1 payload into orbit. Columbia will be launched during a window that opens at 12:38 a.m. EDT and extends for 2-1/2 hours. The mission is scheduled to last 10 days. Landing is set for 7:24 p.m. EDT on June 8.

- end -

NASA sets launch date for Columbia shuttle

CAPE CANAVERAL, Fla. — NASA has confirmed next Wednesday as the official launch date for space shuttle Columbia, grounded for two weeks because of repairs to its cooling system.

"We're ready to go," agency spokeswoman Lisa Malone said following a flight readiness review meeting yesterday.

Columbia will carry seven astronauts and the Astro ultraviolet and X-ray observatory, valued at about $150 million, when it takes off on the first Spacelab mission since 1985. It will be the 36th shuttle flight.

Liftoff is scheduled for 12:38 a.m. EDT, making it the fifth nighttime shuttle launch.

Fri, May 25 1990 USA Today Page A2 STS-35

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May 25, 1990

RELEASE: 90-73

NEW ADVANCED LIFE SUPPORT DIVISION ESTABLISHED AT NASA AMES

How can astronauts grow their own food, live and work on the moon and safely explore the harsh environment of Mars?

Research into these and similar questions will be the prime focus of the newly created Advanced Life Support Division at NASA's Ames Research Center, Mountain View, Calif. William E. Berry, who heads the new organization, said the goal is to support President Bush's plan for a permanent lunar settlement and an astronaut mission to Mars.

Berry said the new division, which consolidates such research efforts at Ames under a single organization, will focus its efforts on developing new technologies that will allow humans to live and work productively in space for long periods of time.

As missions become longer and crews larger, storing or resupplying food, water, oxygen and other consumables becomes prohibitively expensive and difficult. The life support system necessary to meet crew members' daily needs without resupply consists of several elements: thermal control, air revitalization and food, water and solid waste management.

- more -

Berry's division has responsibility for developing several new life support technologies, including:

-- "Closed-loop" life-support systems, using physical or chemical means to generate nutrients, gases and liquids from waste products. Ames is the lead center for development of physical-chemical systems, which use chemical processes to convert carbon dioxide, waste water and solid wastes to breathable air, potable water and food.

-- A "bioregenerative, closed-loop" system, called Controlled Ecological Life Support System (CELSS), using plants to produce food and recycle water vapor, oxygen and carbon dioxide. Work at Ames emphasizes developing a crop growth research chamber and space flight investigations to study the performance of CELSS technology in space and to maximize the growth of edible plants under controlled conditions.

-- Creation of new space suits and portable life support systems. These technologies could be used in the exploration of Mars or the lunar surface. Included is the AX-5 space suit, an all-metal high-pressure suit which for the first time will allow astronauts to exit the shuttle or space station without first breathing pure oxygen for several hours.

This "pre-breathe" phase is currently necessary to prevent the "bends," a life-threatening condition resulting from the formation of nitrogen bubbles in the blood stream.

Berry is conducting a nationwide search for scientists and engineers to join his research and development team. "We are looking for talented, creative people who want to help develop the space technology of the future," he said. "The unique human habitats we will build in space may provide technologies useful in solving some of the critical environmental issues which we face on Earth today."

- end -

NASA FactSheet

National Aeronautics and
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May 31, 1990

SPACE EXPLORATION INITIATIVE OUTREACH PROGRAM

Background

In his July 20, 1989 speech on the anniversary of Apollo 11, President Bush spoke of a long-range, continuing commitment to space exploration. The President spoke first of Space Station Freedom, next back to the Moon and back to stay, and then a manned mission to Mars.

Vice President Quayle directed NASA on Dec. 19, 1989, to query the best and most innovative people at universities, federal research centers, in aerospace and non-aerospace industries and elsewhere to insure that all reasonable conceptual space exploration alternatives have been evaluated.

The Vice President asked NASA to "cast our net widely, drawing upon America's creative potential to ensure that we are benefiting from a broad range of ideas about different architecture, new systems concepts, promising new technologies and innovative uses of existing technologies."

In February 1990, President Bush approved a policy for the Space Exploration Initiative which stated that during the next several years two or more significantly different alternative architectures will be developed, as will new technologies, prior to adopting any baseline for a program request.

NASA has developed an Outreach and Synthesis Process to solicit ideas and to recommend alternative architectures and innovative technologies.

Outreach Program

To ensure access to a broad range of ideas, multiple channels will be employed in the Outreach Program. NASA will solicit ideas from universities, technical societies, professional associations, industry and NASA employees through letters to organizations and a notice in Commerce Business Daily. Responses will be evaluated by the Rand Corporation, which will provide assessments to a high level Synthesis Group.

- more -

NASA will review federally sponsored research. Requests will be made to other agencies for innovatiove ideas. In addition, teams will visit other agencies to better understand work underway. Agencies will be invited to brief the Synthesis Group, as well.

The American Institute of Aeronautics and Astronautics (AIAA) study and conference will provide further input to the process. The AIAA effort includes:

- A survey of AIAA's 40,000 person membership;
- An analysis and study by AIAA's technical committees;
- A report to the Synthesis Group this summer;
- An AIAA Conference in the fall; and
- A final report to NASA in December 1990.

Synthesis

On May 31, 1990, NASA Administrator Richard Truly announced the appointment of Lt. Gen. Thomas P. Stafford, USAF (Retired), as Chairman of the Synthesis Group. The Synthesis Group includes individual members and members representing Federal agencies and will be responsible for synthesizing inputs from all sources into two or more significantly different sets of architectures, as well as technologies to be pursued. The group will report to the NASA Administrator.

Post Outreach and Synthesis Process

The NASA Administrator will report the results and recommendations to the Vice President, Chairman of the National Space Council. The results will be reviewed by the National Research Council, which will report to the National Space Council. The resulting architectures will be studied in depth for the next several years, and the innovative technologies will be developed and demonstrated. At the end of the study period, the President will have the information necessary for selecting a program approach to the Space Exploration Initiative and for making appropriate requests to Congress, as well.

-end-

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NASA FactSheet

National Aeronautics and
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May 31, 1990

SPACE EXPLORATION INITIATIVE

BACKGROUND

On July 20, 1989, the 20th anniversary of the Apollo 11 lunar landing, President Bush called for a long range, continuing commitment to set the United States on course back to the Moon and on to Mars in the 21st century. The President's goals were issued early this year as a series of Presidential policy directives collectively defining the Space Exploration Initiative, whose overall goal is to expand the human presence beyond Earth orbit into the solar system.

The President said: "First, for the coming decade -- for the 1990s -- Space Station Freedom -- our critical next step in all our space endeavours. And next -- for the new century -- back to the Moon. Back to the future. And this time back to stay. And then -- a journey to another planet -- a manned mission to Mars."

In his speech, President Bush asked Vice President Quayle to lead the National Space Council in determining what is needed to transform his proposal into reality. The National Space Council reviewed a NASA study as well as other studies on how to implement the program. As a result, the Vice President and the National Space Council called for a broad search for concepts, ideas, technologies and architectures which could result in a faster, lower cost program and several years of definition of alternative architectures prior to commitment to a baseline approach and a new start proposal to Congress.

A NEW AGE OF EXPLORATION: A MARS TIMETABLE

On May 11, 1990, in a commencement address at Texas A&I University, President Bush for the first time set a timetable for human expeditions to Mars. He declared that the United States should send astronauts to Mars in the next 30 years. The President said, "We stand at a halfway point in our exploration of the immediate solar system -- the planet Earth, its Moon, and the terrestrial neighborhood. Thirty years ago, NASA was founded and the space race began. And 30 years from now I believe man will stand on another planet. And so I am pleased to return to Texas today to announce a new Age of Exploration, with not only a goal but also a timetable: I believe that before Apollo celebrates the 50th anniversary of its landing on the moon -- the American flag should be planted on Mars."

- more -

POLICY IMPLEMENTATION DECISIONS

On March 8, 1990, President Bush announced that he had approved the first of a series of policy decisions for the long-term Space Exploration Initiative (SEI). The President approved a program that will give early focus to technology development and a search for new and innovative technical approaches to the lunar and Mars missions. Among elements in the policy implementation program approved by the President are:

- SEI will include both lunar and Mars program elements.

- The program will include investment in high leverage innovative technologies with potential to make a major impact on cost, schedule and/or performance.

- During the next several years, two or more different human space exploration reference architectures will be developed along with new technologies. Following that, a baseline program architecture will be selected.

- NASA will be the principal implementing agency for SEI. The Department of Defense and the Department of Energy also will have major roles in technology development and concept definition. The National Space Council will coordinate the development of an implementation strategy for SEI.

On March 30, 1990, President Bush announced a policy decision dealing with international cooperation on SEI. The announcement said that SEI will be of profound significance to all mankind and that international cooperation in this endeavor is feasible and could offer significant benefits to the U.S. Accordingly:

- The United States will seek an exploratory dialogue on SEI with Europe, Canada, Japan, the Soviet Union and other nations.

- The dialogue will focus solely on conceptual possibilities for cooperation and will be based on guidlines to be developed by the National Space Council taking due account of U.S national security, foreign policy, scientific and economic interests.

-end-

Vera Hirschberg
Headquarters, Washington, D.C.
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NASA News

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(Phone: 202/453-9183)

For Release:
May 31, 1990

3:30 P.M. EDT

RELEASE: 90-74

NASA ADMINISTRATOR ANNOUNCES EXPLORATION OUTREACH PROGRAM

NASA Administrator Richard H. Truly today announced that NASA has launched an Outreach Program to seek new and innovative ideas, systems and technologies to carry out the nation's Space Exploration Initiative (SEI). The Outreach Program is in response to Vice President Quayle's request to "cast the nets widely" for new approaches.

Truly today also announced the appointment of former astronaut Lt. Gen. Thomas P. Stafford, USAF (Retired), as Chairman of the Synthesis Group, which will play a key role in the Outreach Program. This group will study innovative ideas and recommend two or more significantly different alternative architectures, as well as technology priorities and early milestones. The group will report to Truly.

The Outreach Program seeks approaches to mission and system concepts; and innovative, high leverage technologies that could significantly affect cost, schedule and performance for SEI, which sets the future course of the U.S. civil space program.

President Bush announced the SEI on July 20, 1989, the 20th anniversary of the Apollo 11 lunar landing. At that time, he proposed a long-term continuing commitment to complete Space Station Freedom; return permanently to the Moon; and send a manned expedition to Mars. On May 11, 1990, in a speech at Texas A&I University, President Bush declared that before the 50th anniversary of the Apollo 11 lunar landing (2019), "the American flag should be planted on Mars."

Truly said the SEI outreach program is "solid and thorough" and "will leave no stone unturned to reach out to the very best and brightest in our nation." To gather information, concepts and data from the most creative minds in government, industry, academia and elsewhere, Truly said the program takes a three pronged approach. This consists of direct solicitation of ideas; a review of Federally sponsored research; and a study by the American Institute of Aeronautics and Astronautics (AIAA).

- more -

The solicitation effort will include a letter from Truly to organizations that can provide the highest leverage, such as universities, professional societies, associations and others. It also will include an announcement in Commerce Business Daily, which reaches aerospace and non-aerospace industries and others.

The Rand Corporation will conduct an initial screening and assessment of submissions and report to an external Synthesis Group to be composed of government and non-government individuals. The Synthesis Group will report directly to the NASA Administrator. This group also will receive inputs from the Department of Defense, the Department of Energy and other organizations. The results of this activity will also be made available to the National Research Council for review.

The AIAA study is already underway. Its purpose is to solicit and assess innovative approaches to SEI from AIAA's 40,000-person membership and technical working groups. Reports will be coordinated at a conference and workshop to be sponsored by AIAA in September 1990.

-end-

NASA news releases and other information are available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. For information on CompuServe, call 1-800/848-8199 and ask for representative 176. For information on GEnie, call 1-800/638-9636.

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For Release:

Terri Sindelar
Headquarters, Washington, D.C.
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May 31, 1990

RELEASE: 90-75

SPACE GRANT COLLEGE AND FELLOWSHIP PROGRAM PHASE II ANNOUNCED

NASA today announced a second competition under the National Space Grant College and Fellowship Program. Phase II, which will result in the selection of Space Grant State Consortia, provides all states not now a part of the program the opportunity to compete. The District of Columbia and Puerto Rico also are eligible.

The National Space Grant College and Fellowship Program was authorized by Congress to help strengthen and enhance, through the nation's universities, U.S. capabilities in aerospace science and technology.

Objectives of the program are: (1) to establish a national network of universities with interests and capabilities in aeronautics, space and related fields; (2) to encourage cooperative programs among universities, aerospace industry and federal, state and local government; (3) to encourage interdisciplinary training, research and public-service programs related to aerospace; (4) to recruit and train professionals, especially women, underrepresented minorities and persons with disabilities, for careers in aerospace science and technology; and (5) to promote a strong science, mathematics and technology education base from elementary through university levels.

In 1989, NASA Administrator Richard H. Truly implemented Phase I of the program by selecting 21 universities and consortia as Designated Space Grant Colleges and Consortia. These universities and consortia currently are carrying out activities designed to achieve program objectives.

- more -

Under Phase II, states can compete for grants in one of two categories. Program Grants are appropriate for states that presently have colleges and universities with nationally competitive aerospace research and educational capability. Funds will be used for initiating new programs and enhancing existing activities which contribute to the goals of the National Space Grant College and Fellowship Program. Capability Enhancement Grants are appropriate for states wishing to use the funds to develop their aerospace research infrastructure to more competitive levels.

Grants of $150,000, part of which must be matched with non-federal funds, will be awarded annually for 4 years to state consortia in both categories. Grantees in both categories will administer fellowship programs for students at both undergraduate and graduate levels.

NASA will accept only one proposal per state. To insure that only one proposal per state is submitted for evaluation, each institution wishing to participate is required to submit to NASA a letter of intent specifying the university's interest in participating and willingness to collaborate with other interested institutions in the state. NASA will notify interested parties so that collaboration may proceed.

Letters of intent are due by June 29, 1990. Proposals are due Oct. 29, 1990. NASA will announce Phase II grant recipients in early 1991.

- end -

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For Release:

Mark Hess
Headquarters, Washington, D.C.
(Phone: 202/453-4164)

May 31, 1990

Cam Martin
Langley Research Center, Hampton, Va.
(Phone: 804/864-6123)

RELEASE: 90-76

APOLLO 204 CAPSULE TO REMAIN AT THE LANGLEY RESEARCH CENTER

NASA has decided to keep the Apollo 204 capsule at the Langley Research Center, Hampton, Va., for an indefinite period of time. The capsule has been stored at Langley since 1967.

Astronauts Virgil I. (Gus) Grissom, Roger B. Chaffee and Edward H. White II perished in the Apollo 204 spacecraft fire on Jan. 27, 1967. Their deaths occurred on Launch Complex 34, Cape Canaveral Air Force Station, Fla., during prelaunch tests for the first manned Apollo mission.

- end -

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Reporter transcription asked for distances from planets to Voyager 1.

For Release:

Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/453-1547)

June 4, 1990

EDITORS NOTE: N90-40

NASA BRIEFING ON SOLAR SYSTEM IMAGE AND NEW FINDINGS

NASA will present new information from the Voyager missions to the outer planets and a portrait of the solar system at a press conference on June 6, 1990, at 2 p.m. EDT, NASA Headquarters auditorium, 400 Md. Ave., S.W., Washington, D.C.

Voyager Project Scientist Dr. Edward C. Stone of California Institute of Technology, Pasadena, Calif., will discuss the findings of Voyagers 1 and 2 obtained by the two spacecraft at Jupiter, Saturn, Uranus and Neptune between 1979 and 1989.

Dr. Stone also will reveal a portrait of the solar system (Sun, Venus, Earth, Jupiter, Saturn, Uranus and Neptune) taken by Voyager 1 last Feb. 14, when the spacecraft was 3.7 billion miles from Earth. Dr. Carl Sagan, Cornell Univ., Ithaca, N.Y., will remark on the image as well. In addition, a new, 5-minute video will be shown, recapping the voyage to the outer planets and demonstrating how the image of the solar system was taken.

The conference will be carried live on NASA Select television, Satcom F-2R, transponder 13, 72 degrees W. longitude, with 2-way question and answer capability.

- end -

"Last Light Picture"

Stone: @ $200,000 to make this "portrait of the planets"

Sagan: JPL programmers got smart faster than the spacecraft "got stupid." Uranus, Neptune photos are better than those taken at Saturn, Jupiter."

Stone: "Voyager 1 may reach heliopause after turn of century."

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Lisa Malone
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

For Release:
June 6, 1990
noon EDT

N90-41

EDITORS NOTE: BRIEFING ON STATUS OF SHUTTLE COLUMBIA

Space Shuttle Director Robert L. Crippen will hold a press briefing on Thursday, June 7, at 2 p.m. EDT, to discuss the results of the investigation into the cause of a hydrogen leak on Space Shuttle Columbia, the repair efforts that will be made and the impact those repairs will have on the near-term Shuttle manifest. The briefing will be held in NASA Headquarters 6th floor auditorium, 400 Maryland Ave. S.W., Washington, D.C.

The briefing will be carried on NASA Select television, which is available on Satcom F-2R, Transponder 13, C-band located at 72 degrees W. longitude, frequency 3960.0 MHz, vertical polarization, audio monaural 6.8 MHz.

- end -

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Jeffrey Carr
Johnson Space Center, Houston
(Phone: 713-483/5111)

For Release:
June 7, 1990
Noon EDT

RELEASE: 90-77

VETERAN ASTRONAUT HAWLEY TO ACCEPT EXECUTIVE POSITION AT AMES

Dr. Dale Compton, Director of NASA's Ames Research Center, Mountain View, Calif., today named Astronaut Steven A. Hawley as the Center's Associate Director (acting). Hawley will assume his duties on July 29 as the center's third-ranking executive.

"We are extremely pleased," Compton said, "to have someone with Dr. Hawley's administrative and scientific skills joining us at Ames."

Hawley, 38, has served as Deputy Chief of the Astronaut Office since 1987 and most recently as mission specialist aboard the Space Shuttle Discovery on mission STS-31 in April of this year. During that flight, he successfully delivered the Hubble Space Telescope to orbit using Discovery's robot arm and extended his total time in space to over 412 hours.

The three-time Shuttle flight veteran was selected as an astronaut in 1978. Hawley worked as a simulator pilot in the Shuttle software laboratory and on astronaut support crews for Shuttle missions STS-2, STS-3 and STS-4 before making his first space flight.

- more -

He first flew as a mission specialist on the maiden voyage of Discovery, STS-41D, in August 1984. Discovery's crew deployed three communcations satellites and activated the OAST-1 solar cell wing experiment. He made his second trip to orbit aboard Columbia on STS-61C in January 1986, during which Hawley participated in the deployment of the SATCOM KU satellite and conducted experiments in astrophysics and materials processing.

Hawley's hometown is Salina, Kansas. An honors graduate of the University of Kansas, he will be returning to the San Francisco bay area, where he earned his Ph.D. in Astronomy and Astrophysics from the University of California, Santa Cruz, in 1977.

In 1988, Hawley was awarded the NASA Exceptional Service Medal. He is a member of the American Astronomical Society, the Astronomical Society of the Pacific, Sigma Pi Sigma and Phi Beta Kappa.

Hawley is married to the former Eileen M. Keegan of Redondo Beach, Calif. His parents, Dr. and Mrs. Bernard Hawley, live in Rancho Mirage, Calif.

- end -

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For Release:
June 11, 1990

RELEASE: 90-79

NASA SIGNS AGREEMENT WITH CONSORTIUM OF MINORITY UNIVERSITIES

NASA Deputy Administrator J.R. Thompson today witnessed the signing of a memorandum of understanding (MOU) between NASA and representatives of a newly-formed academic consortium comprising 6 minority universities. The MOU establishes the NASA Space Technology Development and Utilization Program Consortium (STDP), designed to increase minority universities involved in NASA research and technology development.

The consortium includes North Carolina A&T State University, Greensboro; New Mexico Highlands University, Las Vegas; Central State University, Wilberforce, Ohio; Southern University, Baton Rouge, La.; Jackson State University, Jackson, Miss.; and Tuskegee University, Tuskegee, Ala.

"This collaboration creates an infrastructure to enhance and strengthen each university's science and engineering research programs. It also will help increase representation of Blacks, American Indians and Hispanics in these fields. This effort significantly exceeds any previous jointly-pursued minority university inititative," said Thompson.

The infrastructure provides for effective management and technical interfaces with numerous organizations, such as NASA program offices and field centers, minority academic institutions, the private sector and the minority business community.

The program approach includes several major components:

* The university consortium component combines participants' technical, scientific and engineering skills, providing a balanced team to engage in a range of research activities.

- more -

* The private sector component integrates high technology capabilitites of major corporations with research capabilities of minority universities. To facilitate the private sector component, BDM International Inc., a Ford Aerospace Company, will provide both program management and technical support.

* The minority business enterprise component assists with transferring technologies and results of applied research to minority businesses for development and commercial applications.

As part of the agreement, NASA will fund 7 research projects, 20 graduate student fellowships and 31 undergraduate student scholarships, totalling about $1 million.

Several program benefits include developing a large pool of minority science and engineering undergraduate and graduate students participating in NASA research; increasing opportunities for faculty exchange; providing summer internships, co-op programs and faculty research fellowships with government and industry; providing minority universities with direct interaction with technology-oriented industry and with government; and supporting viable commercial development and technology transfer to industry.

BDM has developed a data base called RESOURCE to provide NASA, other federal agencies, industry and other researchers information about academic programs, research programs, equipment and faculty at minority institutions.

The STDP is coordinated by NASA's Minority University Program Office in the Office of Equal Opportunity Programs, at NASA Headquarters. Program oversight is maintained at NASA's Langley Research Center, Hampton, Va., in the Office of the Chief Scientist.

- end -

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Technology Utilization Foundation, New York, N.Y.
(Phone: 212/490-3999)

For Release:
June 12, 1990

RELEASE: 90-80

NASA ANNOUNCES FIRST NATIONAL TECHNOLOGY TRANSFER CONFERENCE

The National Aeronautics and Space Administration will sponsor a 2-day conference in November 1990, to promote within industry a greater awareness of the agency's emerging technologies through its Technology Utilization Program. Planned as an annual event, TECHNOLOGY 2000 will be the first industrial exposition and conference to showcase the transfer of the agency's technology to American business.

Scheduled Nov. 27-28, 1990, at the Washington Hilton Hotel, Washington, D.C., TECHNOLOGY 2000 will feature speakers and exhibitors from NASA and its contractors, addressing both prior and potential spinoffs of the agency's research. Speakers will spotlight both current and planned research and development efforts, including innovations now coming on line from the Mission to Planet Earth Program, the National Aero-Space Plane, and Mars mission and lunar base research.

Preliminary plans for the technical symposia include such topics as software engineering, materials sciences, sensor technology, computational fluid dynamics, communications, robotics and artificial intelligence, and biomedicine.

The goal of TECHNOLOGY 2000 is to support the national technology transfer program by increasing awareness of existing NASA-developed technologies available for immediate use and by laying the groundwork for the effective use of emerging technologies being planned and developed for future missions. The target audience is the non-aerospace segment of industry that traditionally has had minimal participation in NASA's research and development programs.

- more -

Co-sponsors of the conference and exhibition are Technology Utilization Foundation, a non-profit organization which will manage the show, and NASA Tech Briefs, a monthly magazine devoted to the transfer of the agency's technical innovations to American industry.

Additional information on TECHNOLOGY 2000 is available by contacting:

Technology Utilization Foundation
41 East 42nd Street
New York, N.Y. 10017
(Phone: 212/490-3999)

- end -

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For Release:
June 13, 1990

RELEASE: 90-81

NASA ANNOUNCES NEXT STEPS IN SPACE EXPLORATION OUTREACH PROGRAM

NASA today has taken the next steps in its Space Exploration Initiative (SEI) Outreach Program to solicit innovative ideas on how to return to the Moon permanently and to begin human exploration of Mars. NASA Administrator Richard H. Truly announced the Outreach Program on May 31.

The steps included a mass mailing from Truly to institutions and individuals, the announcement of a telephone number for public requests for response packets and publication of an announcement soliciting ideas in the Commerce Business Daily, which reaches both aerospace and non-aerospace industries.

In a personal solicitation, Truly sent more than 3,200 letters to presidents of U.S. colleges and universities, deans of engineering schools, chairs of college and university science and engineering programs, presidents of science and engineering professional associations and others.

He asked for ideas on mission concepts and their architectures and for ideas on the systems and technologies required for travel to the Moon and Mars and for living and working productively on both worlds. His letter included a response packet to be forwarded to the RAND Corp. in Santa Monica, Calif. NASA asked RAND to conduct an initial analysis and evaluation of the responses.

RAND has established a toll-free telephone number for requesting an SEI Outreach response packet. The number is 1-800/677-7796.

In announcing the SEI Outreach Program, Truly said that NASA would "leave no stone unturned to reach out to the very best and brightest in our nation" to gather information, concepts and data to carry out SEI.

-end-

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For Release:
June 14, 1990

RELEASE: 90-82

MAKING FRESH VEGETABLES ON LONG-DURATION SPACE TRAVEL

The first working model of a "salad machine" that eventually will provide a variety of fresh vegetables for astronauts on long voyages is now growing its first crop at NASA's Ames Research Center, Moffett Field, Calif.

Dr. Mark Kliss, project manager and principal investigator, said one of the first things astronauts and submariners ask for, following days or weeks of eating freeze-dried or preserved foods, is fresh produce. "Our goal is to produce such a variety of fresh salad vegetables for consumption by the crews of Space Station Freedom and other long-duration missions," Kliss said.

The presence of plants and the ability to "cultivate" a garden also can improve the crew members' morale by providing something for them to nurture and by offering a creative outlet during their free time, much like tending a garden on Earth, he said.

Garden-variety plants such as leaf lettuce, carrots, radishes, onions, sprouts, tomatoes, peppers and cucumbers are being considered for inclusion in the salad machine. Most candidate vegetables have very similar temperature, humidity, lighting and nutrient requirements, thus simplifying the environmental control system. Because of limited space, some plants will be smaller than the varieties commonly found on Earth.

- more -

Tomato plants, for example, will be less than 12 inches high. And because there is no gravity, some of the vegetables will grow "upside down" or "sideways," although in the weightlessness of space there is no true "up" or "down."

Kliss' goal is for the salad machine to produce three salads per person per week for a crew of four. It also will recycle the water transpired by plants back into the nutrient delivery system. Eventually, Kliss hopes the salad machine can use recycled water to grow plants and produce potable water for crew consumption.

It also will furnish oxygen-enriched air to the cabin environment after particulates and excess water vapor are removed. Food production, carbon dioxide scrubbing, oxygen generation and water purification are key functions of the "bioregenerative" life support systems being developed by the Advanced Life Support Division at Ames.

Project engineers also face formidable engineering constraints. The amount of space available is limited to a single standard space station rack of 36 inches by 41.5 inches by 80 inches, or about 28.2 cubic feet of growing volume. The machine must operate on less than a kilowatt of power, produce a minimal amount of waste heat and provide light for the plants.

A nutrient delivery system must be designed which can provide water and necessary nutrients to the growing plants, while keeping fluids in place in microgravity, or weightlessness of space. Kliss said that proper humidity will be maintained by recycling condensed water vapor, which also will decrease the amount of resupply water needed.

The process of growing plants in the salad machine should be relatively simple. Seeds, contained in a cassette for ease of handling in microgravity, will be germinated for a few days. Once the seeds sprout, they will be placed in the plant growth chamber containing the nutrient delivery system. Kliss expects the activity of "planting" seed cassettes and harvesting mature plants to require 15-20 minutes of an astronaut's time every few days. By applying commercial hydroponic (soil-less) growing techniques, plant growth time from seed to harvest is much quicker than for field-grown counterparts.

Kliss hopes to have the salad machine fully operational by Space Station Freedom's scheduled completion later this decade.

- end -

EDITORS NOTE: Available to the media only are 3 photographs of the "salad machine:"

Black and White	Color
90-H-464	90-HC-441
90-H-465	90-HC-442
90-H-466	90-HC-443

Also available to the media are a line drawing of the design concept (90-H-468) and a video tape. Material can be obtained by calling NASA Headquarters Audio-Visual Branch, 202/453-8375.

NASA news releases and other NASA information is available electronically on CompuServe and GEnie, the General Electric Network for Information Exchange. For information on CompuServe, call 1-800-848-8199 and ask for representative 176. For information on GEnie, call 1-800-638-9636.

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For Release:
June 14, 1990

RELEASE: 90-83

COMMERCIAL EXPERIMENT TRANSPORTER PLANNED

The National Aeronautics and Space Administration today announced support for plans to develop a system for launching and recovering commercial spaceborne experiments.

Sponsored by NASA's Office of Commercial Programs, the objective of the Commercial Experiment Transporter (COMET) program is to develop both hardware and infrastructure to facilitate the commercial development of space by the United States. NASA's Centers for the Commercial Development of Space (CCDS) initiated the program and will be totally responsible for system design, fabrication, test and operations in which industry will be encouraged to be innovative.

"Proceeding with this innovative concept represents another significant step in the commercial development of space," said James T. Rose, NASA Assistant Administrator for Commercial Programs. "The COMET program will help provide the access to space that is critical in meeting industry's needs."

Carried aloft by an expendable launch vehicle, the COMET free-flyer will contain both a service module and a recovery system. The two components will separate prior to reentering the atmosphere so that most experiments will be returned to Earth in the recovery system, while others not requiring retrieval, could continue their mission aboard the service module.

-more-

There are six major elements to the COMET program: launch vehicle and services, payload integration, the service module, orbital operations, recovery system and services, and systems engineering. Contractors will be expected to provide key hardware and services for each segment of COMET development and operations.

The COMET program plans call for a mid-1992 launch of a free-flyer, weighing up to 1,800 pounds, into an equatorial orbit with an inclination of about 40 degrees. Commercial experiments and processes to be returned to Earth will be carried out during a nominal 30-day mission, while non-recoverable payloads can remain on orbit in the service module for a year or longer. Completion of the second phase of flight will result in reentry of the recovery system and its payload at a site within the continental United States. Specific launch and recovery locations have not been defined since industry will be allowed to propose the most cost-efficient method to meet mission requirements.

Launching the COMET on expendable rockets offers experimenters flexibility in selecting orbital parameters which are different from those of the Space Shuttle. Additionally, the free-flyer will stay in orbit longer and can carry industrial research materials that could be hazardous to the Shuttle and its crew.

The lead CCDS, the Center for Advanced Space Propulsion (CASP) located at the University of Tennessee Space Institute, Tullahoma, will be responsible for program management and systems engineering. Other participating CCDSs include:

- Center for Macromolecular Crystallography, University of Alabama-Birmingham (payload integration);

- BioServe Space Technologies, University of Colorado, Boulder (recovery system);

- Center for Space Power, Texas A&M University, College Station (service module);

- Consortium for Materials Development in Space, University of Alabama-Huntsville (expendable launch vehicle); and

- Space Vacuum Epitaxy Center, University of Houston (orbital operations).

The CCDS team, through CASP, will prepare statements of work, evaluate proposals and, upon contractor selection, provide technical observation and contract monitoring. The University of Tennessee-Calspan Center for Aerospace Research, the legal entity for CASP, will issue a request for proposals this summer. Joseph F. Pawlick Jr., CASP, is the COMET program manager.

-end-

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For Release:
June 20 , 1990

RELEASE: 90-84

NASA/USAF X-29 RESEARCH AIRCRAFT SET FOR PUBLIC VIEWING

The NASA/USAF X-29 forward-swept-wing research aircraft is scheduled for its first public display, away from its Southern California base, at two major air shows in July.

The X-29's first appearance will be at the Dayton, Ohio, air show from July 19-22. Subsequently, the aircraft will be displayed at the Experimental Aircraft Association's International Convention and Sports Aviation Exhibition, Oshkosh, Wis., July 27-Aug. 2.

The airplane is the first of two X-29s built to obtain flight information on the unusual wing design and various other technologies, including the extensive use of light weight, composite materials in the wing's construction. Flight testing has proved that the forward-swept-wing design is practical.

There will be no aerial demonstration of the X-29 at either air show. NASA and Air Force personnel will be available at the display sites to answer questions.

During its 4-year flight test program, the first X-29 flew 242 missions -- a record number for an X-series high-performance aircraft. It has been in storage since December 1988. The second X-29 is continuing to gather data in a high angle-of-attack flight research program.

The joint NASA/USAF program is managed by NASA's Ames-Dryden Flight Research Facility, Edwards, Calif., and the Wright Research and Development Center, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio. The Defense Advanced Research Projects Agency sponsored development of the X-29. Grumman Aircraft Corp., Bethpage, N.Y., manufactured the two aircraft.

- more -

Stephen D. Ishmael, Ames-Dryden Chief X-29 Research Pilot, will fly the aircraft to Dayton and Oshkosh. Other pilots currently flying the X-29 are NASA's Rogers E. Smith, Grumman's Rod Womer and Air Force Major Dana D. Purifoy.

The X-29 is 48-feet long with a 27-foot wingspan and is powered by a single General Electric F404-GE-400 engine. Its paint scheme, white with a broad accent stripe of dark blue on its fuselage and wings outlined in red, emphasizes the plane's unique wing configuration.

- end -

NOTE TO EDITORS: A photograph is available to media representatives to illustrate this release by calling 202/453-8375.

Color: 90-HC-446 B&W: 90-H-470

NASA News

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Washington, D.C. 20546
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For Release:
June 21, 1990

RELEASE: C90-w

SILICON GRAPHICS, INC., WINS WORKSTATION CONTRACT

NASA's Ames Research Center, Mountain View, Calif., has awarded Silicon Graphics, Inc., of Mountain View a workstation contract valued at about $32.8 million.

Under the contract, Silicon Graphics will provide Powervisions graphics workstations for use in the Ames Numerical Aerodynamic Simulation (NAS) Processing System Network. The firm also will furnish system software, maintenance, analyst support and training for all workstation purchasers.

The 5-year contract has a basic ordering period of 3 years and an additional 2-year period for maintenance. Other NASA users and federal agencies can buy the workstations through the Ames contract.

The NAS Processing System Network performs computational fluid dynamics and other large-scale scientific simulation and modeling applications. The new graphics work stations will let network users, analyzing NAS simulations, to visualize their results.

By providing scientific computational and visualization services and tools to a wide range of users within NASA and around the United States, the network influences the direction of aerodynamic research throughout the aerospace industry.

- end -

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For Release:
June 21, 1990

C90-x

NASA SELECTS STUDY CONTRACTORS FOR PHASE B ATDRSS CONTRACT

NASA's Goddard Space Flight Center (GSFC), Greenbelt, Md., has selected Ford Aerospace Corp., Space Systems Division, Palo Alto, Calif.; General Electric Co., Astro-Space Division, Princeton, N.J.; Hughes Aircraft Co., Space and Communications Group, Los Angeles, Calif.; and TRW Inc., Space and Technology Group, Redondo Beach, Calif., to negotiate separate firm-fixed price contracts for Phase B definition design studies of the Advanced Tracking and Data Relay Satellite System (ATDRSS).

The firm-fixed-price for each of the 11 month contracts is $7,500,000. The contracts will become effective approximately August 1, 1990. These contracts, which constitute the second of three phases in the ATDRSS procurement, will require each contractor to produce a definition phase design including trade studies, a Space Network functionality assessment, and a TDRSS to ATDRSS transition plan.

Proposals for Phase C/D of the procurement for ATDRSS fabrication and implementation will be solicited with a separate request for proposal. It is NASA's intent to select one contractor to perform Phase C/D.

The ATDRSS will continue the function of the Tracking and Data Relay Satellite System (TDRSS) through the year 2012. This program will be jointly managed by the GSFC TDRS Project and the GSFC Space Network Project Office.

-end-

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For Release:
June 21 , 1990

RELEASE: 90-85

NASA'S JET PROPULSION LABORATORY TESTS PLANETARY ROVER

Scientists and engineers at NASA's Jet Propulsion Laboratory, Pasadena, Calif., have begun an extensive period of field testing of a semi-autonomous navigation system on a computer-operated robotic vehicle prototype for possible use in future planetary explorations.

Brian Wilcox, supervisor of the Robotic Sensing and Perception Group, said the summer-long testing program would be carried out mostly in the Pasadena Arroyo, a dry river bed, adjacent to JPL.

Developing new technologies, including a new generation of planetary rovers, is seen as critical to the success and cost effectiveness of the Space Exploration Initiative (SEI) program announced by President Bush last July. The Planetary Rover project will develop systems for the manned and unmanned vehicles needed for surface transportation.

Surface transportation systems required by SEI include unmanned rovers for outpost site survey and for regional robotic exploration and science, piloted rovers for transportation both locally and long range, and unmanned cargo handling, construction and mining.

Increased traverse distance, longer life and autonomous operations are required for the unmanned roving vehicles for the program. Traverse distances of up to several kilometers per Earth day and a mission life from 1 to 5 years are desired for the next generation of robotic exploring vehicles.

- more -

The operation of an autonomous unmanned rover in a location remote from the Earth, such as the surface of Mars, with round-trip communications time, at the speed of light, between 8 and 40 minutes, involves an entirely unproven technology.

Two advanced forms of unmanned rover navigation are under development at JPL. They are computer-aided remote driving (CARD) and semi-autonomous navigation (SAN).

The CARD technique allows a human operator to remotely drive a vehicle by planning and identifying an extended (10s of meters) obstacle-free path with a three dimensional display of images from stereo cameras aboard the vehicle. The path then is transmitted to the vehicle for atonomous execution.

The SAN technique allows a human operator to determine a nominal extended route (10s of kilometers) for the vehicle, with the specific path taken by the vehicle around local obstacles determined automatically from the rover's sensor data and stored data base.

JPL's prototype rover made its first, continuous semi-autonomous navigation (SAN) traverse, in rough natural terrain, on May 7, 1990.

The navigation testbed is a six-wheeled, three-body, articulated vehicle the experimenters call Robby. It is about 13-feet long, 5-feet wide and more than 6.5-feet high. Its 35-inch diameter wheels and articulated body permit it to go over obstacles a meter high.

The 2,500-pound vehicle contains two computer systems, one for perception and planning and one for control of the actuators in the wheel drive and arm control. The robotic arm has six links and 6 degrees of freedom with an additional pivot axis and gripper providing two more degrees of freedom.

There are four cameras on the pan-tilt head capable of stereo correlation to provide three-dimensional images of objects. A motor generator provides 3,500 watts of power and batteries provide 24 volts.

Other parts of the rover program include the development of advanced mission operation, mobility and power technology at JPL; the development of an innovative legged vehicle concept, as opposed to using wheels, at Carnegie Mellon University in Pittsburgh, Pa.; mission operations research at the Ames Research Center, Moffett Field, Calif.; and piloted rover technology at the Marshall Space Flight Center, Huntsville, Ala.

- end -

EDITORS NOTE: Available to the media only are two photographs of the planetary rover:

Black and White:	90-H-471
Color:	90-HC-447

Material can be obtained by calling NASA Headquarters Audio-Visual Branch, 202/453-8375.

A two-minute video clip to accompany this release will air on June 22 at 1 p.m. EDT on NASA Select television - SATCOM F2R, transponder 13, 72 degrees W. Longitude. This videoclip can also be obtained by contacting the NASA Headquarters Audio-Visual Branch.

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For Release:
June 21, 1990

RELEASE: 90-86

CONTEL TO TRANSFER TITLE OF TDRSS TO NASA

Officials of NASA's Goddard Space Flight Center (GSFC), Greenbelt, Md., and Contel Federal Systems, Chantilly, Va., signed an agreement today transfering the title of the Tracking and Data Relay Satellite System (TDRSS) to NASA, effective July 1, 1990.

Under the agreement, Contel will transfer ownership of the space communications system 42 months earlier than called for under the original contract. Contel also will get a 21-month extension, to Sept. 30, 1995, to continue operating the three on-orbit satellites and the Whites Sands ground terminal.

"The early transfer of the title, along with other contract modifications, is expected to save the government $16 million", according to William A. Hatchl, TDRSS Project Procurement Manager at GSFC.

The original 1976 contract covered construction of the six spacecraft and ground communications terminal, maintenance and operations for 10 years.

- end -

NASA News

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For Release:
June 22, 1990

RELEASE: 90-87

NASA SELECTS 37 STUDENTS FOR GLOBAL CHANGE FELLOWSHIP PROGRAM

Continuing its efforts to encourage the next generation of scientists and engineers, NASA has selected 37 graduate students at U.S. universities to take part in the Global Change Fellowship Program.

The Global Change Fellows, students pursuing Ph.D. degrees, were selected by a panel of representatives from the Earth Science and Applications Division, Office of Space Science and Applications (OSSA) and the Educational Affairs Division at NASA and from professional scientific societies and universities. Fellowships of $22,000, beginning in the 1990-91 academic year and renewable for 3 years, will be awarded based on research proposals submitted by the selected applicants.

The selected students, from the United States and 10 other countries, represent 28 U.S. institutions of higher learning. Their proposals included research in atmospheric physics and chemistry, biogeochemistry, data and information systems, ecosystems, hydrology, oceanography and solid-Earth sciences.

"The thing we hope to do," said Dr. Shelby G. Tilford, Director of OSSA's Earth Science and Applications Division, "is encourage and train a new generation of Earth scientists, who may one day be responsible for much of the analysis of data from the Earth Observing System."

The Earth Observing System (EOS) is NASA's proposed series of space platforms that would carry suites of related instruments to study the interaction of Earth's biological, geological and chemical systems and the effects of those interactions on the environment. If approved by Congress in the Fiscal Year 1991 budget, the first EOS platform would be planned for a Fiscal Year 1998 launch.

- more -

NASA hopes to have 150 fellowships in effect annually by the time the first platform is launched. The wide range of disciplines represented among the selected proposals reflect the interdisciplinary nature of NASA's Mission to Planet Earth, which incorporates most of the agency's Earth science programs in an effort to understand the Earth as a unified system. The goal of Mission to Planet Earth, as part of the U.S. Global Change Research Program, is to increase our understanding of the environment and improve ability to predict changes on a global scale.

Though fellows are under no obligation to work for the government or even to continue in the Earth sciences, NASA is counting on the attraction and increasing emphasis on environmental issues to keep the students working in their areas.

Fellowship proposals were evaluated based on academic excellence of the student, quality of the research proposal and relevance to NASA's role in the U.S. Global Change Research Program.

The selected students, their institutions and areas of research are:

Atmospheric Chemistry:
Margaret K.M. Brown, University of Washington; Steven Andrew Lloyd, Harvard University; Young Sunwoo, University of Iowa; Renyi Zhang, Massachusetts Institute of Technology.

Atmospheric Physics:
Timothy Michael Del Sole, Harvard University; Carter Lee Grotbeck, University of Arizona; Stephen A. Klein, University of Washington; Jon Thomas Nelson, University of Washington; Thomas Carl Peterson, Colorado State University; Eric Paul Salathe, Yale University; Brian Jon Soden, University of Chicago.

Biogeochemistry:
David William Bolgrien, University of Wisconsin-Milwaukee; Anne Marie Braunschweig, University of Minnesota-Twin Cities; Stephen Kimber Hamilton, University of California-Santa Barbara; Ann P. Kinzig, University of California-Berkeley.

Data and Information Systems:
James William Hardin, Texas A&M University.

Ecosystems:
Tracy Lea Benning, Kansas State University; William Michael Childress, Texas A&M University; Lars Lowell Pierce, University of Montana; John Frederick Weishampel, University of Virginia.

Hydrology:
Afshan Alam, Penn State University; Ana Paula Barros, University of Washington; Wesley Keith Berg, University of Colorado-Boulder; Vannaroth Nuth, University of Texas-Austin; Scott Dale Peckham, University of Colorado-Boulder; Richard Warner Turner, Iowa State University; Randolph H. Wynne, University of Wisconsin-Madison.

Oceanography:
Mary-Lynn Dickson, Oregon State University; Maria Christina Forbes, University of Miami; Jacqueline Kerry Holen, Stanford University; Laura Lee Landrum, University of Washington; Cecile Mauritzen, Massachusetts Institute of Technology; Joanna Elizabeth Muench, University of Washington; Susan Elizabeth Wifjjels, Woods Hole Oceanographic Institute; Edward D. Zaron, Oregon State University.

Solid Earth Sciences:
Andrea Szilagyi, Purdue University; Thorvaldur Thodarson, University of Hawaii-Manoa.

- end -

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For Release:
June 27, 1990

RELEASE: 90-88

NASA CHOOSES INDUSTRY/UNIVERSITY IN-SPACE TECHNOLOGY STUDIES

NASA's Office of Aeronautics, Exploration and Technology (OAET) has selected 11 proposals for development of space flight technology experiments and 4 proposals for further study in its In-Space Technology Experiments Program (IN-STEP).

Since 1987, IN-STEP has stimulated the aerospace engineering community to work with NASA in making greater use of the Space Shuttle, expendable launch vehicles and Space Station Freedom for space research and technology experiments.

The current program provides technology advancements that will extend U.S. leadership in space. The latest solicitation was second in a series sponsored by OAET.

The 11 proposals selected for development of space flight technology experiments are:

* "Electrolysis Performance Improvement Concepts Study," Life System, Inc., Cleveland

* "Liquid Motion in a Rotating Tank," Southwest Research Institute, San Antonio, Texas

* "In-Step Venting Experiment," Martin Marietta Corporation, Astronautics Group, Denver

* "Large Inflatable Paraboloid Accuracy Measurement," L'Garde, Inc., Tustin, Calif.

* "Development and In-Space Evaluation of a High Stability Hydrogen-Maser Clock," Smithsonian Institution Astrophysical Observatory, Cambridge, Mass.

* "In-Step Integrated Two-Phase Thermal Experiment," TRW Space and Technology Group, Redondo Beach, Calif.

- more -

* "Space Cryogenic System Experiment," Hughes Aircraft Co., El Segundo, Calif.

* "Jitter Suppression for Precision Space Structures," McDonnell Douglas Missile System Co., St. Louis

* "Measurement and Modeling of Joint Damping in Space Structures," Utah State University, Logan, Utah

* "Permeable Membrane Plant Nutrient Delivery Experiment," Boeing Aerospace and Electronics Co., Seattle

* "Mode II: Reflight of the Middeck Zero-Gravity Dynamics Experiment with the Middeck Active Control Experiment Test Article," Massachusetts Institute of Technology Space Engineering Research Center, Cambridge, Mass.

The four proposals for further study are:

* "Sodium Sulfur (NaS) Battery Flight Experiment," Ford Aerospace Corporation, Palo Alto, Calif.

* "Optical Properties Monitor," AZ Technology, Huntsville, Ala.

* "Risk-Based Fire Safety," University of California, Los Angeles (UCLA)

* "Microgravity Measurement & Management," University of Alabama at Huntsville, Huntsville, Ala.

- end -

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For Release:
June 28, 1990

RELEASE: C90-y

STERLING FEDERAL SYSTEMS GETS SOFTWARE SUPPORT CONTRACT

NASA's Ames Research Center, Mountain View, Calif., has awarded a cost-plus-award-fee support services contract valued at about $210.8 million to Sterling Federal Systems, Inc., Palo Alto, Calif.

Sterling will provide computational support for problem applications and systems programming, systems design and engineering, software management, and maintenance and modification of existing software. The contract has a 3-year basic period of performance, plus one 2-year option period. The anticipated start date is July 1, 1990

Sterling has had a similar contract at Ames since 1970. The new contract covers approximately 400 current Sterling employees, a number that may increase to 600 by 1995.

- end -

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For Release:
June 29, 1990

N90-47

EDITORS NOTE: TRULY, FISK AND LENOIR TO HOLD MEDIA BRIEFING

NASA Administrator Richard H. Truly, Associate Administrator for Space Science And Applications Dr. Lennard Fisk and Associate Administrator for Space Flight Dr. William Lenoir will hold a media briefing in the NASA Headquaters 6th floor auditorium on Monday July 2. The briefing will begin at 10:30 a.m. EDT and will be carried live on NASA Select television via Satcom F2R, Transponder 13, at 72 degrees west longitude, frequency 3960.0 MHz.

- end -

NASA News

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For Release:
June 29, 1990
5:45 p.m. EDT

RELEASE: 90-89

HYDROGEN LEAK DISCOVERED ON SHUTTLE ATLANTIS

A propellant loading test of the STS-38 Space Shuttle vehicle, slated to conduct a dedicated Department of Defense mission in mid-July, revealed a hydrogen leak. Although similar to the leak that caused the postponement of the STS-35/Astro-1 mission, the leak appears to be smaller than the one detected during the tanking exercise on the STS-35 vehicle prior to its rollback to the VAB and demating.

Engineers today loaded the Shuttle's external fuel tank to about the 5 percent level to check for leaks in the umbilical between the orbiter Atlantis and the fuel tank. Instrumentation located in the umbilical area detected hydrogen shortly after the fueling process went from a slow fill to a fast fill mode.

Engineers believe the leak is in a cavity between the orbiter and external tank umbilical plates. While the leak's precise location is not known, tests today indicate the 17" line between the orbiter and the ET used to feed hydrogen to the orbiter's three main engines is contributing to the leak. The leak appears to be both temperature and flow-rate dependent.

Columbia is currently in the Orbiter Processing Facility (OPF). Its umbilical has been removed and is scheduled to be shipped to Rockwell-Downey this weekend for installation in a test stand for further leak testing. Tests of the ET side of the STS-35 umbilical did not reveal any leaks large enough to account for the leak seen during tanking of the STS-35 vehicle.

- more -

Leonard Nicholson, Deputy Director, Space Shuttle Program, will lead the NASA/industry team charged with analyzing the cause of the leak and determining corrective actions.

Until the cause of the leak has been determined, further processing of the STS-38 vehicle has been suspended. When the problem has been identified it is expected that STS-38 will be brought back to the VAB and the orbiter demated from the tank to make the necessary repairs. While a new target date is not known for the STS-38 launch, it is expected the flight will be delayed a minimum of two weeks.

Briefings to the news media updating the progress on the investigations are tentatively planned for Tuesday, July 3 and Friday, July 6 from NASA Headquarters, Washington, D.C.

- end -

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